Effective Implementation of Value Engineering in the Housing Construction Programmes of the UAE

by

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DECLARATION

This work or any part thereof has not previously been presented in any form to the University or to any other body whether for the purposes of assessment, publication or for any other purpose (unless otherwise indicated). Save for any express acknowledgments, references and/or bibliographies cited in the work, I confirm that the intellectual content of the work is the result of my own efforts and of no other person.

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ABSTRACT

Balancing time, cost and quality is one of the major challenges impacting the housing programmes of the United Arab Emirates (UAE). Therefore, this study was undertaken with the main aim of determining the impacts of the tools and principles of value engineering on public sector housing in the UAE. The study also aimed to develop a framework to define the guidelines of a value engineering methodology to improve the execution of government housing projects, along with a reduction in the level of risk. The five dependent variables in the study were: achievement of needs, conflict avoidance, affordability of housing, competitive advantage and reduced cost of production. The two independent variables were value engineering in design and value engineering in the procurement process. To accomplish the aim and objectives of the research, both primary and secondary research approaches were used. The secondary research was conducted through a literature review while the primary research was conducted using both qualitative and quantitative approaches. The quantitative research involved a survey of value engineers, contractors and employees of construction companies in the UAE. The number of fully completed questionnaires was 102, and the primary data collected was analysed using descriptive statistics and regression and correlation analyses. Subsequently, qualitative data was collected through interviews in order to gain deeper insights into the subject matter. Thirty interviews were conducted with housing officers, directors and value engineers associated with housing construction projects. The interview data was analysed using content analysis. The analyses suggested that the five dependent variables were significantly correlated with the implementation of value engineering in design and procurement. On the basis of these findings, a framework was developed and validated by 40 experts. This framework can be applied in the UAE to make housing and other construction projects affordable and sustainable and to meet the full needs of clients as well as end users.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Abbreviations

AED/DH: United Arab Emirates Dirham
BIM: Building Information Modeling
BREEAM: Building Research Establishment Environmental Assessment Method
CAD: Computer Aided Design
CASSH: Comprehensive Assessment System for Sustainable Housing
CSR: Corporate Social Responsibility
DCLG: Department for Communities and Local Government
GCC: Gulf Cooperation Council
GDP: Gross Domestic Product
IVM: Institute of Value Management
KRI: Khazanah Research Institute
KSA: Kingdom of Saudi Arabia
LSE: London School of Economics and Political Science
MBRHE: Mohammed Bin Rashid Housing Establishment
MENA: Middle East and North Africa
MEP: Mechanical, Electrical and Plumbing
PMDC: Project Management and Design Consultants
PPP: Public-private partnership
PPP: Purchasing power parity
RM: Risk Management
SAP: Systems, Applications, and Products
SAVE: Society of American Value Engineers
SD: Standard Deviation
UAE: United Arab Emirates
UK: United Kingdom
UN-HABITAT: United Nations Housing Rights Programme
UPC: Abu Dhabi Urban Planning Commission
USA/US: United States of America
USD: United States Dollars
UTM: Universal testing machine
VA: Value Analysis
VE: Value Engineering
VECP: Value Engineering Change Proposals
VM: Value Management

ACKNOWLEDGEMENTS

Sheikh Zayed bin Sultan Al Nahyan, the founder of UAE once said that, “our major aims focus on raising the standard of living of our citizens and the development of our country. One’s homeland is like a tree which constantly requires the care and attention of its citizens. Every UAE citizen is committed to serve his nation and work toward its prosperity and welfare”. This saying reflects the powerful impact that education may have on people and the nation as a whole. This saying made me realize that as a citizen of UAE, it is my duty to contribute towards the nation’s development. I felt that by undertaking this research, I would be able to use my education and knowledge to contribute towards my country’s growth and development.

I would like to thank Allah who has helped me to complete this research from its very beginning and till the end.

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I am so grateful for the support of my educators, who helped me in this research work to gather information regarding the UAE housing programs.

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CHAPTER 1 – INTRODUCTION

1.1 Value management terminology – SAVE international

The Society of American Value Engineers (SAVE) is the leading international society that emphasises the advancement and promotion of the Value Methodology. The various tools included in this methodology are as follows:

Value engineering (VE): This term was defined by Lawrence Miles during World War II, arising due to the scarcity of resources that occurred during the war. The term was a creative one, and refers to modifications and changes that take place in project designs (Phillips, Martin, Dainty, & Price, 2008).

Value analysis (VA): This term refers to the analysis of value techniques. It is also used for the overall analysis of a project's performance and completion.

Value management (VM): This term, also defined during World War II, refers to the process of obtaining the maximum output from resources. This is an effective tool that is employed to accomplish a project's objectives and achieve clients' aims and goals (Phillips, Martin, Dainty, & Price, 2008).

Value assurance: This factor is defined as the improvements, changes, or modifications to tools and techniques, and changes that take place in a business project. This approach is used for large-scale projects, and to achieve greater returns and profits from a particular project (Phillips, Martin, Dainty, & Price, 2008).

Value control: This term encompasses the collection of data, project planning, development, cost control, and risk involved in a certain project.

Value improvement: This term refers to the selection of a project, as well as the cost analysis, development, suggestions, functional analysis, and improvements needed for the project to achieve its objectives.

The SAVE international standard states the practices of generic methodology, while the common terminology provides guidelines for managers and practitioners so that they can apply Value Management (VM) effectively and efficiently. This standard is used to enhance the value of projects, and is helpful in identifying the correct time when the value methodology should be applied in the project's life cycle. VM is performed to gain the maximum value for customers throughout the systematic completion of the project. VM is used to suggest the most appropriate life cycle for a project, given the various possibilities (Kelly & Male, 1993). Through this standard, the innovation skills of team members are valued and enhanced, while alternative procedures are identified in a quest to increase the overall value of the project. In other words, it can be said that VM is a compilation of techniques that are brought together to provide direction to a project's team members.

VM offers a structured job plan whose ultimate aim is to enhance the value of a project. It serves to identify a project's fundamentals, function, and aims so that team members are better placed to work in a certain way so as to achieve the ultimate goals of the project.

1.2 Introduction to the UAE construction industry

1.2.1 History of the UAE construction revolution

The oil revolution of 1961 resulted in the transformation of Abu Dhabi, which is one of the largest of the emirates that make up the UAE. The wealth obtained from the first oil concessions yielded only a marginal benefit, but supported the development of low-rise buildings and paved roads that were constructed from 1961.

Eventually, revenues from oil began to increase, and Sheikh Zayed bin Sultan Al Nahyan—the ruler of Abu Dhabi for more than 30 years—embarked on a number of construction programmes in areas such as housing, schools, roads, and hospitals. Despite the 2008 financial crisis, the UAE construction industry has continued to flourish until the present day, involving a number of mega projects such as the Emirates Tower, the Dubai-Fujairah Highway, Dubai International Airport, and Ferrari World Abu Dhabi (Construction Week Online, 2009). In the context of these major construction projects, VM tools and methodologies are increasingly used by project managers in the UAE (Construction Week Online, 2009). However, the use of Value Engineering (VE) in the

UAE construction sector is still a more recent development (Jeyakumar, 2013). VE is the analytical and structured process followed to achieve value for money by enabling the most important functions of built products at the lowest cost. The concept of VE has been in use in developed countries for decades, and is seen as a tool that has supported some of the most prominent challenges in the construction industry (Ahmed & Pandey, 2016). The changing economy of the UAE has generated a storm of demand for VE and VM; there have been a number of construction projects in the UAE that would have benefited from an increased focus on quality, efficiency, and cost, which indicates there is significant scope for the adoption of VE (Construction Week Online, 2009). It is in this context that this research examines the implementation of VE in the UAE.

1.2.2 Population of the GCC and UAE

The Gulf Community Council (GCC) consists of six states that have a total population of more than 54 million. According to the most recent calculations, the population of Saudi Arabia is 34,689,518, that of the UAE is 9,863,234, that of Oman is 5,076,085, that of Kuwait is 4,256,114, that of Qatar is 2,869,857, and that of Bahrain is 1,687,329 (Worldometers, 2020). The UAE—also known as the Emirates is located towards the south-east of the Arabian Peninsula (Worldometers, 2020). Figure 1.1 details the location of the UAE.

Figure 1.1: Geographical location of the UAE

Source: (Atlas, 2016)

Figure 1.2 shows the population growth of the UAE that has taken place in the period 2008–2018. The graph indicates that there has been a significant growth in the population, from 8.77 million in 2012 to 10.43 million in 2018 (Trading Economics, 2018), and predicts that the population of the UAE will continue to grow, reaching 11.77 million by 2022 (Statista, 2018).

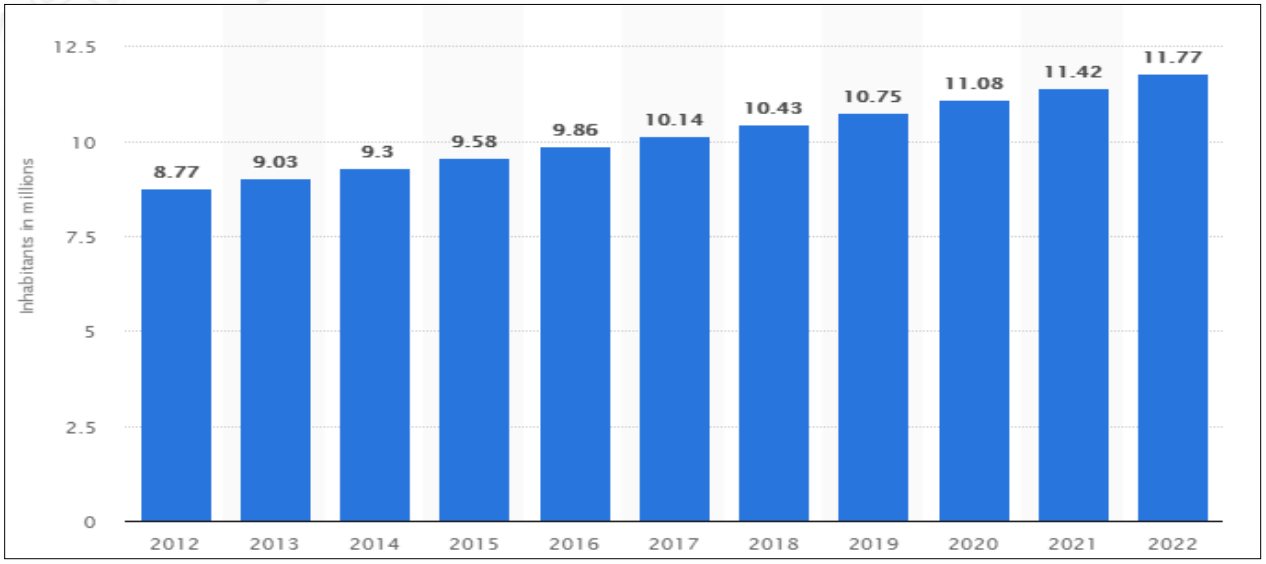

Figure 1.2: Population growth in the UAE
Source: (Statista, 2018)

1.2.3 The UAE housing sector (government housing programme)

The Sheikh Zayed Housing Programme was established in 1999, based on a vision of providing adequate and stable housing for UAE nationals and their families; at the same time an e-government programme was initiated by the UAE Ministry of Public Works and Housing to provide intranet access to assist the work of construction services and teams. Under the Sheikh Zayed Housing Programme, the UAE government allocates land and provides free housing, loans, and residential facilities to deserving Emiratis. Anyone claiming a service under this programme must be a family breadwinner who can demonstrate that his/her sum total of assets and income is insufficient to purchase a good house (Abu Dhabi Government, 2015). Non-refundable grants are available to develop new houses, carry out expansion or maintenance on existing houses, and purchase or build new houses. Interest-free loans are also available. The housing facilities provided are either separate residential units or located within residential compounds built by the government and provided to the beneficiary upon completion (Abu Dhabi Government, 2015). In 2019, the programme approved Dh 410 million to support 522 housing assistance applications by

Emirati citizens, while in 2020, a grant of Dh 395 million was agreed to offer housing loans and grants to 503 citizens who have voiced their wish to purchase a residence (Gulf News, 2019). The Sheikh Zayed Housing Programme offers a range of services, including:

- Interest-free loans to: purchase or construct a new house; maintain or expand an existing house; and construct or purchase more than one house, if the family situation demands it;
- Government housing within residential compounds or as separate residential units; and
- Non-refundable grants to purchase or construct new houses, for maintenance or expansion, and to construct or purchase more than one house, if the family situation demands it.

The UAE supports sustainable housing developments in order to preserve the local environment. The government seeks to maintain a balance between social and economic development, and the Sheikh Zayed Housing Programme is one such effort being pursued to accomplish these objectives. It is hoped that the programme will ensure a high standard of living for all UAE citizens (Ministry of Finance, 2015).

1.2.4 Factors affecting the UAE construction industry

Some of the major factors that affect the UAE construction industry are geography, cost, and government support. These are discussed as follows:

Geography: The UAE is largely desert, previously inhabited by nomadic Bedouin tribes, before being taken over by fishing villagers and date farmers. Sixty years ago, infrastructure in Abu Dhabi amounted to a few hundred palm huts, known as 'barsati' huts, and a few coral buildings and forts, while Dubai was the trading hub of UAE, home to good and safe construction facilities. Life has changed considerably in the UAE in recent decades, and the geography of the country has significantly influenced the construction industry (Ghanem, 2015).

The UAE has developed into an international business centre and tourist destination; it has the highest per capita income in the world, and the real estate and construction industries are a major contributor to the country's economy.

Cost: The Incremental Capital Output Ratio (ICOR) is calculated to show the additional units of capital or investment required to produce an additional unit of output (Hayes, 2019); a lower ICOR

indicates higher productivity of capital. A delay in investment will increase the ICOR because it delays the entire construction project, resulting in time and cost overruns. In other words, it reduces the productivity of the capital, leading to a reduction in growth rates due to inevitable delays in projects. This is a common problem in the UAE, and needs to be eradicated as soon as possible. The root cause of this problem is excessively tight construction schedules (Memon, Rahman, & Azis, 2011).

In 2014, 66% of the country's projects were on hold; it has been estimated that more projects are placed on hold or cancelled in the UAE than in any other GCC country, generating losses of trillions of dollars in the industry. This background reveals the urgent need to change the nature of the UAE construction industry, given that the largest project markets in the region are the UAE and Saudi Arabia (Nesan, 2015).

Government support: In 2013, a total of 3,000 Emiratis received housing assistance (Ahmad, 2013). In the years leading up to 2014, the Dubai Prime Minister Sheikh Mohammad approved Dh 3.6 billion for construction-related loans (Bhatia, 2015), while in 2011, the Abu Dhabi UPC signed various agreements with major real estate developers within the Emirate to build at least 7,500 homes in Abu Dhabi, Al Ain, and the western region for an approximate total cost of AED 13.5 billion, aiming to build 15,000 residential houses by 2015 (Abu Dhabi Government, 2014). Furthermore, in 2019, a grant of Dh 410 million was sanctioned in response to 522 housing assistance applications, while so far in 2020, Dh 395 million in home loans and grants has been sanctioned to help 503 citizens who wished to purchase a home (Gulf News, 2019).

1.3 Problems in the construction industry

There are a number of reasons that have given rise to the research problem, which are explained below.

1.3.1 Increases in the cost per year of housing construction

The UAE's construction industry is experiencing an increase in the cost of construction per year. There was a rise in the cost of construction of between 1.8% and 2.3% from the first quarter of 2017 until the first quarter of 2018 (Gulfnews, 2018), while there has been an upward movement in the cost of construction materials (Gulfnews, 2018). The UAE government is taking active steps

to reduce its reliance on oil and gas, such as by offering generous opportunities to local firms to expand their products and services so as to reduce the country's dependence on the oil and gas sector. This approach has promoted the development of the construction and infrastructure sectors (Haider, 2016), which is in turn is attracting a large number of businesses to the country, thereby boosting the government's overall revenue from economic sectors other than oil and gas.

These construction activities are boosting the leisure tourism industry (Oxford Business Group, 2017) and playing an essential role in diversifying the economy away from oil and gas (Abbas, 2018). The current cost of the construction of a medium-specification villa in the UAE is between Dh 3,490 and Dh 4,277 per square metre, while that of high-specification villas is between Dh 5,377 and Dh 6,390 per square metre (Gulfnews, 2018). However, the Middle East has experienced a much lower increase in construction in comparison to locations such as New York and Hong Kong (The National, 2014) because governments' higher earnings from oil cannot be translated into investment immediately (Kassem, 2018).

The figure 1.3 below shows that the UAE construction industry significantly contributes to the country's GDP. By 2021, the construction sector is expected to contribute over 11.5% of GDP, proving the importance of improving the efficiency of this sector.

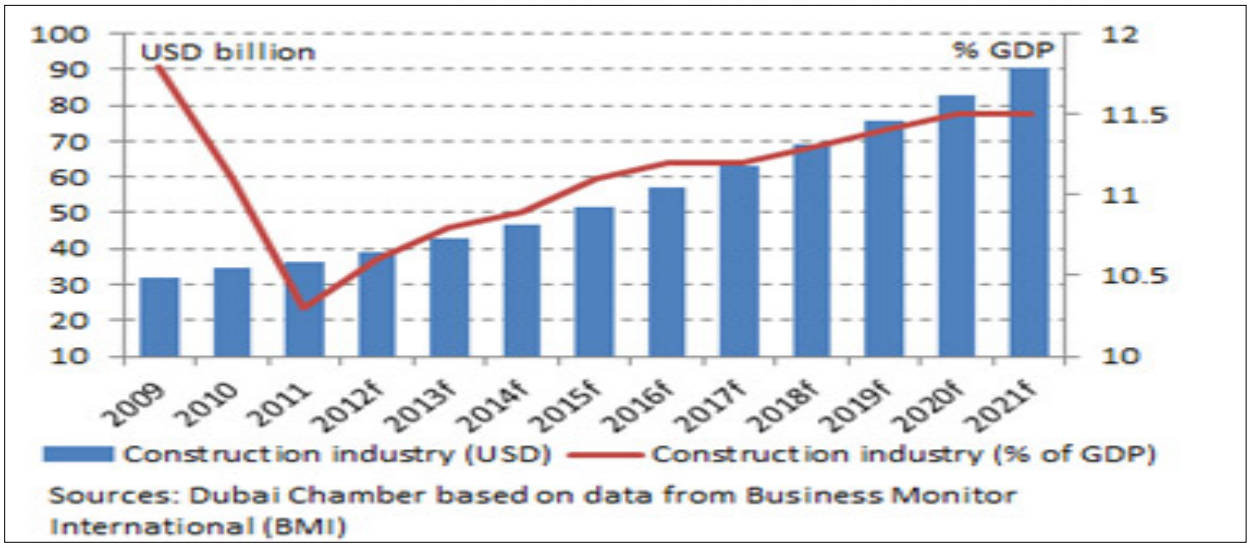

Figure 1.3: The contribution of the construction sector to the GDP of the UAE, 2011–2021

Source: (Abdel-Kader, 2018)

This growth depicted in Figure 1.3 has occurred due to the liberalisation of real estate and property laws. Major construction projects in the UAE include (Ren, Atout, & Jones, 2008):

- Burj Khalifa and the Sheikh Zayed Grand Mosque (Sultan, Weir, & Karake-Shalhoub, 2012). Burj Khalifa is one of the biggest projects ever completed in the UAE, but it was a let-down in terms of cost. The initial planned cost of the Burj was around $876 million, but the actual cost exceeded $1.5 billion (Al-Kodmany, 2015).
- Al Maktoum International Airport. The estimated cost of the project was $27 billion (Departures, 2017), but the actual cost was $33 billion (Airport-technology, 2016).
- Dubai World Central (DWC) and Dubailand. The budgeted cost of the DWC was $32 billion (Wordpress, 2007), but the actual cost was $64 billion (Airport-technology, 2016).

The above examples indicate that the costs of all major construction projects in the UAE have been far higher than the estimated costs. These unexpected increases in the costs of construction projects is one of the major issues facing the UAE construction industry.

1.3.2 Reasons for construction project delays

Delays in the construction industry are a major issue and are caused by a number of factors, including miscommunication between stakeholders and inaccurate estimates in terms of cost and time (Ahmed & Pandey, 2016). These delays cause significant increases in the overall cost of projects; the cost of a project is directly proportional to the time necessary for project completion (Shah, 2016). One of the best examples of how project delays increase the overall cost of construction projects in the UAE is Burj Khalifa; its delays caused a huge cost increase from $876 million to $1.5 billion (Al-Kodmany, 2015). The findings produced by Ejaz, Ali, & Tahir (2016) indicate that the major causes of delays in construction projects include the price escalation of building materials, mismanagement, poor communication, poor supervision, and shortages of materials and equipment. In order to prevent such increases in cost, it is essential to solve the abovementioned challenges (Ejaz, Ali, & Tahir, 2016).

Construction projects in the UAE are commonly delayed due to price escalations associated with building materials and faulty management, while many consultants blame poor supervision and mismanagement by contractors. Overall ranking analyses indicate that delays can be attributed to

increases in the prices of materials, inadequate control procedures, shortages of technical staff, delays in work approval, and shortage of materials and plant equipment.

Some of the major factors that cause delays in projects are as follows (Ren, Atout, & Jones, 2008):
Client issues:

- Poor communication
- Regular intervention
- Variations in orders
- Late approval for payments
- Delayed supply of information
- Project objectives not being clear
- Extra prime costs and provisional sums
- Less time apportioned for project completion

Consultant issues:

- Incomplete contract documents
- Inaccurate drawings
- Ineffective design management
- Lack of skilled labour
- Improper time estimation

Contractor issues (Ren, Atout, & Jones, 2008):

- Lack of effective organisation management
- Scarcity of technical professionals
- Uncontrolled external and internal environments
- Poor planning
- Inappropriate quality control standards
- Improper mobilisation
- Incompetent project teams
- Lack of experience
- Inappropriate allocation of funds

It is extremely important to eradicate the abovementioned problems to ensure that housing standards are not hampered by delays in construction. To ensure that projects are completed on time, it is necessary to analyse the above factors in detail for every project, and then implement practical changes accordingly. It is also beneficial to adopt VM approaches to ensure value for money in construction projects, and reduce the effects of delays in delivery. The concept of VM is related to VA, in that it is a problem-solving approach. VA is implemented via the use of various sets of techniques, groups of skilled personnel, and bodies of knowledge. All these factors are integrated based on the objective of achieving value for money in construction projects, thereby ensuring timely delivery and the safeguarding of resources (Shen & Yu, 2015).

1.3.3 Thousands of UAE families await government support

Partnership agreements have been promoted in the UAE from the year 2000 onwards in order to increase the efficiency and efficacy of housing construction. Previously, many citizens were unable to afford housing and as a result, the government introduced various policies to ensure that ordinary people would have access to basic amenities (Ren, Atout, & Jones, 2008).

The UAE government needs to consult with relevant professionals in order to decide on the scope of VE implementation. Doing so would enable the government to understand the extent to which VE can improve the performance of the construction industry to such a level that the government will be able to achieve its goals and objectives in a timely manner, without using more resources than necessary (Shen & Yu, 2015). Furthermore, the government should evaluate how to integrate a VM approach into every construction project it undertakes to ensure value for money in each project, as well as evaluate the effectiveness of VE at reducing costs, overcoming delays, and meeting the needs of housing customers. To this end, the government would do well to consider the examples set by countries in which VM has helped to ensure basic housing standards for citizens (Shen & Yu, 2015). The United Kingdom (UK) and the United States of America (USA) are two such countries that have extensively utilised VM in their projects (Oke & Aigbavboa, 2016), while VM has also gained importance in Malaysia, ever since the issuance of Circular 3/2009 by the Economic Planning Unit (EPU), which has resulted in significant cost reductions in Malaysian construction projects (Jaapara, Maznan, & Zawawi, 2012).

VM is an extremely important factor in the construction sector (Designing Buildings, 2018), being an accurate basis from which to take important decisions on projects by clearly defining relevant value for both users and owners. For example, VM offers a functional mechanism that can be used to measure value by considering both the monetary and non-monetary benefits associated with construction projects (Designing Buildings, 2018). In addition, VM is a tool to optimise the balance between the expectations and needs of stakeholders. VM will also help the UAE government to reduce the cost of a project, as well as to improve its overall effectiveness (Designing Buildings, 2018).

1.3.4 Statement of the research problem

The increasing costs of housing in the UAE is one of the major problems affecting the population of the country (Khaleej Times, 2017), and costs are increasing year on year (Arabian Business, 2015). Housing in the UAE tends to follow traditional patterns and is culture- orientated, but has become a serious issue for many people as a result of these spiralling costs and delays.

The increasing use of glass in the construction of houses is one reason why the cost of housing in the UAE has ballooned. Other aspects of the country's culture that are important in this regard include the costs of building materials and labour, among a range of other unforeseen circumstances not considered at the conception and design phases, which can significantly affect project costs (Anyanwu, Asigo, & Urowu, 2015).

With ever increasing costs, the problem is: how can housing remain affordable to all Emiratis? Companies and project managers in the UAE need to pay closer attention to cost (as well as time and quality) factors as they work to complete housing programmes, and it is in this light that this study considers how VM can help to overcome these challenges.

1.4 Research aim and objectives

The aim of this research is to explore the impact of VE on various aspects of public-sector housing programmes implemented in the UAE. The sub-aim is to develop a framework to promote the effective implementation of VE in the UAE construction sector.To achieve the research aim, the following objectives are proposed:

- To explore the role of VE and strategies that promote its implementation in the UAE construction industry;
- To determine the challenges of implementing VE in the UAE construction sector;
- To determine the benefits to be gained by implementing VM in the provision of public-sector housing in the UAE;
- To identify the impact of VE on the UAE construction industry;
- To determine the best practices associated with VE/VM for housing projects; and
- To develop guidelines for the use of VE to improve the provision of housing in the UAE.

1.5 Research question

This study hopes to be able to answer the following key research question:

- How can the benefits of VE and VM be realised in the context of UAE public-sector housing programmes?

1.6 Research methodology in brief

The researcher first reviewed various publications and previous studies in order to determine the current state of knowledge and thinking surrounding VM and VE. The ensuing empirical study was exploratory in nature because the aim of this research was to gain insights into and explore the research questions. The study was conducted by collecting primary data on the provision of public housing in the UAE by means of a questionnaire and follow-up interviews. The interview participants included professionals supervising two government housing programmes (the Sheikh Zayed and the Mohamed bin Rashid & Emirati programmes), as well as a number of other professionals working in the UAE construction sector. The participants were selected by means of both probability and non-probability sampling; the survey participants were selected based on a

simple random sampling method, and the interview participants by using the convenience sampling method.

The data from the questionnaire survey were analysed via descriptive, regression, and correlation analyses, while the data from the interviews were evaluated by means of content analysis in order to gain insight into the current status of VE and VM in the UAE, and to suggest measures that can be taken to improve these practices. The results of the study have been employed to develop a framework that can guide future developers or procurers of public-sector housing schemes in the UAE.

1.7 Organisation of the thesis

The thesis is made up of a total of ten chapters. Chapter 1 is the introduction, which provides a brief information to the topic and discusses the research problem, aim and objectives. Chapter 2 consists of a literature review of the concepts of VE and VM, and the utility of VM models. Chapter 3 is a literature review of the UAE housing industry. Chapter 4 is also a literature review, which covers international perspectives on social housing. Chapter 5 discusses the conceptual framework of the research study, while Chapter 6 details the research methodology adopted by the researcher to accomplish the overall objectives. Chapter 7 consists of an analysis of the quantitative data while Chapter 8 does the same for the qualitative data. Chapter 9 charts the development and testing of the new framework. Finally, Chapter 10 presents the conclusions and recommendations of the study.

CHAPTER 2 – A LITERATURE REVIEW OF VALUE ENGINEERING AND VALUE MANAGEMENT

2.1 Introduction to Chapter 2

This chapter discusses the importance of VE in the context of the UAE housing and construction industry. The chapter begins by discussing the concepts of VE and VM, before looking in more detail at the VM model. The later sections of the chapter focus on the UAE's international employment plan and how it is used to overcome some of the challenges facing the housing industry in the country.

2.2 Value engineering

The Society of American Value Engineers (SAVE) was formed in 1959, with the name being changed to SAVE International in 1996 (Value Eng, 2016). The VE methodology was first developed in 1982, and was rapidly put to use by the US Ministry of Defence. It is a value chain methodology that is designed to add value to clients' needs by improving performance, quality, and life-cycle cost management.

It is important to provide a clear understanding of the meaning of the term 'value'. According to Ashworth (2006), human actions are driven and motivated by value; when people require or need something, value is the potential objective. The primary driving force that mediates between demand and supply is value (Ashworth, 2006).

Value is a type of measure that can be expressed in terms of effort, exchange, and currency. On a comparative scale, it can reflect the desire to retain or obtain an ideal, item, or service (Annappa & Panditrao, 2012). The relationship between value and function and between value and cost can be represented using the following expression:

Value = Function/Cost

Where the terms are as follows:

Function: the characteristic action or activity for which a thing is used or is suitable, or for which a thing specifically exists.

Cost: the price to be paid

According to the definition proposed by SAVE, value is equivalent to a fair return of services, goods, or even money for something exchanged.

Usually, value is represented and depicted by the following relationship:

Value = Function/Resources

Where the terms are as follows:

Function: the measure of the requirements of the performance of the item.

Resources: measured in terms of the labour, materials, time, or price required to accomplish a certain function (SAVE International, 2015).

In a similar manner, economists and engineers consider value in terms of a product or a service, whereby VA and VE are types of formal methodologies that are used to establish improvements in terms of value, with value being defined as the ratio between function and cost (Shillito & Marle, 1992).

2.3 Value management

The Association of Value Engineering was first established in the UK in 1966, and in 1972 was renamed the Institute of Value Management (IVM). VM was introduced to Japan and Australia in the 1960s, while it arrived in China in 1978, when the country embarked on its open-door and reform period of governance. The next section presents a discussion of the use of VM in certain countries (Kelly, Male, & Graham, 2007).

VM can be defined as a technique that is used to enhance the value of a project (Male, Kelly, Gronqvist, & Graham, 2006). During the 1960s and 1970s, VM techniques became increasingly diverse, mainly through their varying applications in the manufacturing sectors of a range of countries such as Italy, Japan, Canada, and Australia (Chavan, 2013). A turning point for VM came at the beginning of the 1980s lasting until the 1990s, when such techniques were increasingly put to use in international construction projects. Various approaches and perspectives emerged over the world, with nations such as Korea and Japan borrowing a franchised version of VM from the US, and other nations adapting the methodology to fit with their particular national cultures and markets (Male, Kelly, Gronqvist, & Graham, 2006). The next section presents a discussion of the use of VM in certain countries

2.4 The importance of VE and VM in the UAE

The system of VE consists of the actions required to implement improved solutions to problems. Many such approaches are conducted in the form of a job plan. The effectiveness of these approaches derives from the information phase, during which as much information as possible is collected, and new ideas are created following an assessment of the complete knowledge of the situation that needs to be addressed (De Leeuw, 2006).

VE has gained greater importance since 2008, not just as a cost-cutting measure but also to optimise the design to develop an end product that meets the customer's exact requirements, or is even better than the model that was originally proposed. Through VE, property developers in the UAE are able to provide very high-quality designs to customers with greater flexibility and resilience for a similar monetary value to that previously proposed. VE ensures that projects are completed within a pre-determined time and with a minimal probability of failure (Faridi & El-Sayegh, 2006) . Davis (2018) agrees with Faridi & El-Sayegh, and states that the best way to implement VE in a construction project is to plan it well from the beginning with the required resources, allowing for a buffer time interval. After that, the project must be completed within a limited time interval and using a certain amount of resources, employing the best team of engineers available. If all factors are considered from the outset, there is a much higher probability that the project will be successful. VE is ensured through the following steps: gathering the required information; analysing various systems in order to eradicate doubts; reviewing possible design options; developing selected alternatives to provide the best results for the stakeholders; presenting the VE recommendations; and incorporating VE outcomes into the final design (Davis, 2018).

2.4.1 The disadvantages of VE

Some authors such as Salt & Warren (2011) have focused on the disadvantages that can result from the use of VE. One prominent drawback is that it is very easy for managers to conclude that changes can be introduced, and that the process can be modified at any time. However, it is very difficult for managers to actually introduce changes in the middle of a VE process because most companies that employ such processes operate on very large scales, and modifying a VE process could be extremely costly.

Another drawback is that the implementation of VE is a long and time-consuming process that demands a great deal of expertise. VE allows engineers to calculate the time, cost, and resources required at a particular time, but these calculations may not remain relevant for long-term projects that extend over several years. Disputes between contractors and consultants appointed by clients are another typical reason for the incomplete implementation of VE, and such disputes lead to delays in projects, with cost and time overruns (Salt & Warren, 2011).

2.4.2 Rationale for the use of VE

Shen & Yu (2015) published a rationale for the implementation of VE in which they stated that there are almost always certain elements in construction projects that are poor value, and thus should be considered a priority to be addressed. Examples of such elements are: a lack of time to complete the job; poor levels of communication; habitual or traditional aspects of thinking; poor coordination between operations personnel and the designer; honest beliefs in false structures; a lack of state-of-the-art technology; scope for changes to be implemented; an absence of experts necessary for the project; prejudicial ways of thinking; and an absence of basic, valuable, and required information (Shen & Yu, 2015).

Other scholars have asserted that VE and VM need to include the concept of sustainability, which is an area in which many GCC companies fall short; most construction companies in the UAE fail to include sustainability practices in their projects. In their study, Alsaleh & Taleb (2009) interviewed value managers from 17 GCC countries and found that companies in the UAE are particularly unaware of the benefits of sustainability, and therefore would benefit the most from government training in the integration of sustainability practices into the field of VM.

2.4.3 Rationale for the use of VM

In his description of VM, De Leeuw (2006) touched on the importance of VE in the context of the property sector. In essence, VM is an instrument that enhances and improves the functional value of a project from the first to the last step. The commissioning of a project is carried out with the help of an auditor, while decisions regarding the value system are taken by the developer. VM helps to promote the most important functions or processes at the lowest cost by following an organised approach that emphasises optimisation (Shen & Liu, 2004). According to De Leeuw

(2006), VM should be considered an enhancement that offers some functional and aesthetic value, and if a project does not take account of VM, it may have functional appeal, but is likely to lack aesthetic appeal. VM can help to identify and eliminate unwanted costs because it is a highly organised approach. The unwanted costs eliminated by VM are those that do not add quality, value, or customer features to any aspect of the development. VM is an organised and multi-disciplinary approach that serves to identify the functions of a project, and to obtain optimal value throughout its life cycle (De Leeuw, 2006).

According to Othman (2005, 2008), the construction industry in the UAE emphasises customer satisfaction, and delivering housing projects in a timely manner and achieving project objectives to ensure that customers' projects are completed at the cost originally specified. VM and risk management (RM) practices could be hugely beneficial for the UAE's ability to offer low-cost housing projects (Othman, 2008) because they will help to achieve sub-objectives such as increasing incomes, responding to market demand, reducing the cost of projects, reducing maintenance costs, attracting customers, and using substitute materials that are effective. However, one associated risk of implementing VM is a potential loss of customers due to consequent project delays (Othman, 2005).

2.4.4 The connections between VE and VM

VM is a method that highlights opportunities to deliver greater value in projects. It encompasses the complete life cycle of a project, from design to project completion, and emphasises managing important aspects of a project such as cost, time, and performance. Another key focus of the concept is reducing the maintenance costs of projects, managing project schedules, and streamlining the function and performance. Rather than looking at each phase of a construction project in turn, VE seeks to reduce the unnecessary costs generated throughout all phases of the project life cycle, from the design to the close-out phase (Shaw, 2016). VM and VE are two approaches that can be grouped under the same umbrella, in that they are both ways of making a construction project more successful.

2.5 Problems faced by UAE citizens in the housing sector

VM is scarcely used in the UAE because there is a dearth of VE practices in the country (Atout, 2016). The culture of the UAE also affects the implementation of VM and VE, and it is this background that has compelled the author to conduct research to discover the major reasons why these approaches are used so seldom. The UAE population faces a range of problems, as it seeks to gain access to adequate housing, which is a sector that needs to be brought in line with contemporary technology and practices. These problems are to a large extent due to the country's reliance on culture- and tradition-orientated housing projects, and the industry has failed to take account of the fact that times have changed and it is increasingly necessary to implement new technologies to improve housing (Davis, 2018).

As a result of the increasing membership of SAVE International and implementation of VE in the private and government sectors, SAVE's executive board approved the establishment of an Arabian Gulf chapter at the SAVE 1998 conference (SAVE International Value Standard, 2007). SAVE has recognised the challenges of (housing) construction in the GCC and are thrusting VE/VM as contributors to the solutions for addressing these.

Construction delays are a common problem in the UAE. Faridi & El-Sayegah (2006) researched the major factors that lead to such delays in housing and construction projects by means of a quantitative study in the form of a questionnaire; they also investigated aspects of project quality, safety and cost. Their identified major causes of delay include slow decision-making among owners, inadequate planning during the early phases of projects, and the late approval of formal drawings (Faridi & El-Sayegh, 2006).

The third VE conference was held in Kuwait in 2005 in order to spread information about the correct application of VE. Despite this conference, however, there are still a number of common mistakes in practice in the application of VM in the Gulf region. One example of this is the fact that no initiative has been taken by the UAE Ministry of Public Works to set up a VE department or any associated programme, neither has the government sought to promote sustainable development practices in the construction industry. According to a number of authors, construction

companies in the Gulf are barely aware of sustainable housing development practices and have not been provided with training in this area (Alsaleh & Taleb, 2009).

Fong (2004) has written that many decision makers in the Gulf government sector are not satisfied with the application of VE in housing projects because they face a number of implementation issues such as high levels of resistance to change; a refusal to develop skills and performance that could help training and development; ambiguity of vision and a lack of understanding regarding the importance of VM; a lack of reasons to encourage the application of VE; and a lack of support from the Ministry of Finance or any other government authority (Fong, 2004).

2.6 The VM model

The procedures of VM entail a systematic use of techniques and recognised tools that require the help of a multidisciplinary team, and assists the recognition of project functions and their effective allocation. This approach is a very cost-effective way of boosting performance.

VM is a logical process also known as a 'job plan' or a 'value methodology job plan' (SAVE International, 2005). Its main aim is to study, identify, and evaluate major or essential project functions in a systematic manner, while it also promotes an ideology that indirectly brings value improvements (Zhang, Mao, & Abourizk, 2009). The sequential phases of a VM job plan can be outlined as follows:

Study phase relating to the pre-VM methodology

There are four aspects to a VM study: tasks, spaces, elements, and components. A suitable approach is chosen based on the nature of the client's problem, after which appropriate tools and techniques are selected (Male & Steven, 1998).

Information phase

This phase is designed to support the gathering of appropriate information. This information is obtained during the pre-study phase, and then collated, applied, and examined wherever needed.

Function analysis

This is the most important phase of VM because it is here that VM started to be distinguished from other applications. The functions are first determined and then categorised at the primary or secondary level. The components of the study are tested and finally, whatever the result of the function analysis, its cost is analysed (Zhang, Mao, & Abourizk, 2009).

Creative

In this phase, the appropriate function is selected and analysed by means of creative ideas. A VM study is made up of a range of creative ideas.

Evaluation

In this phase, the selected creative ideas are analysed and the most appropriate is selected to achieve or meet the objectives of the project. Alternative ideas that are beneficial or risky are also evaluated in this phase (Abdelghany, Rachwan, Abotaleb, & Albughdadi, 2015).

Development

The objective of VM is to support the objectives of a project, and this requires the best options to be chosen. The development process must consider team members' skills and levels of efficiency, discussions with project staff members, and analyses of other sources of information (Abdelghany, Rachwan, Abotaleb, & Albughdadi, 2015).

Presentation

During this stage, the team will present the new proposal that has been developed in order to offer better value than previously suggested solutions. This is a crucial stage because it is at this time that team members ask the necessary questions to be able to make an informed decision. Some of the major factors that are analysed at this stage are project history, functions, cost, and success requirements. The overall aim of this phase is to develop an outline of the implementation plan (Wsdot, 2020).

Implementation

The chosen ideas receive approval in this phase, while those that are not relevant are rejected (Zhang, Mao, & Abourizk, 2009). One of the key activities in the implementation phase is sharing information among stakeholders regarding the recommendations that have to be implemented in the construction project. The implementation phase also includes meetings that are with project members, after which the deliverables are submitted to the owner (Federal Highway Administration, 2017).

Post-VM methodology

After the completion of all these phases, a report is written and sent to all team members and management staff. In this phase, the value of the proposals is estimated, and this will constitute a final figure for the project (Kurita, 2007).

VM is a systematic approach that has given rise to accepted techniques that recognise the main functions of, for example, a housing construction project. The relationship between cost and performance is measured in the functional phase in order to be able to measure the efficiency of the project. In the evaluation phase, these performances are analysed and users' needs identified so that they can be met. In this way, by the end of the project, value will have been enhanced thanks to the identification of the project's critical functions (SAVE International, 2015).

Value management methodologies are applicable to construction projects, product manufacturing, business processes and systems, and service management departments. These methodologies are applied to the development phase of a project at any level so that alternative ideas can be developed, and thereby enable the project to achieve its particular objectives and goals (Kelly, Male, & Graham, 2007).

2.6.1 VM job plan

In 1997, an international standard for value was drafted, after which it has been periodically modified to integrate subsequent technological changes and coordinate with the norms of international standard organisations and the business environment. Overall, the standard provides practical guidelines for management teams and practitioners to implement VM in a consistent and effective manner. VA, VM, and VE all form part of the value methodology, which is a useful range of applications such as consumer products, industrial products, manufacturing processes, construction projects, business procedures, and business plans and services (SAVE International, 2015).

Another term used in the field of VM is 'value study,' which is simply the formal application of VM (SAVE International, 2015), consisting of a combination of various techniques such as VA, VM, value planning, and VE. A value study refers to the utilisation of international standards, as shown in Figure 2.1, and incorporates the process, product procedure, service, and design of a project. The structure of a value study is dictated by the job plan, and is made up of three steps, as follows:

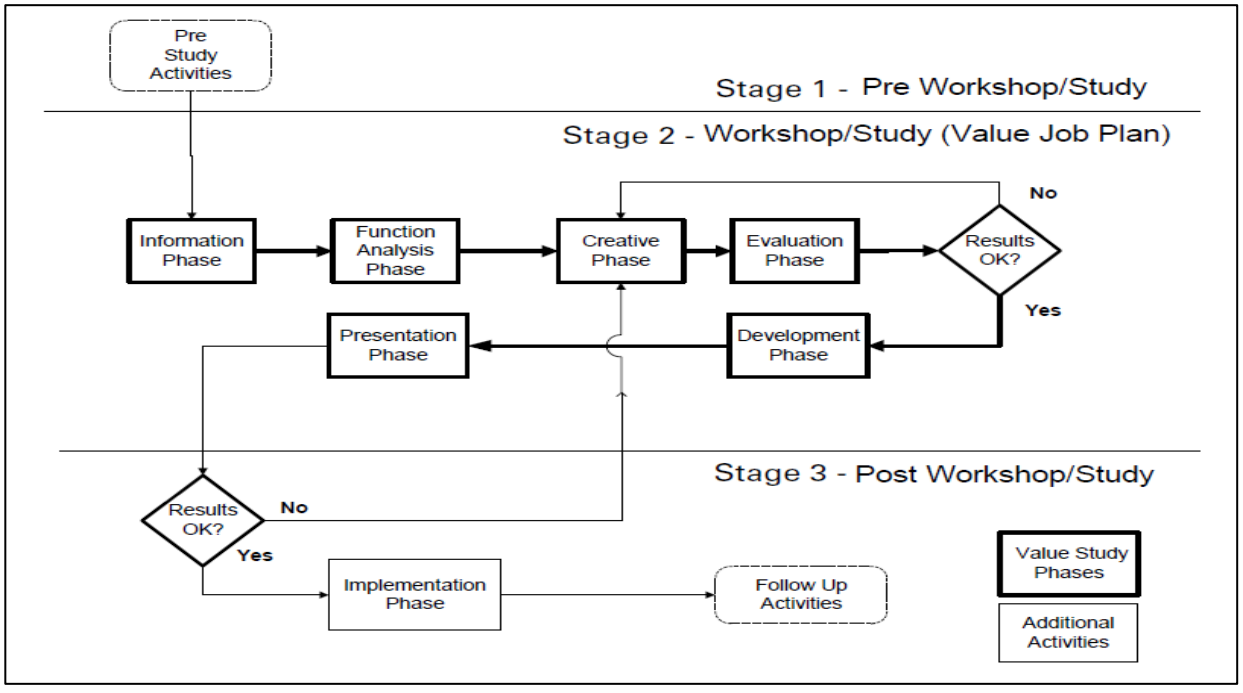

Figure 2.1: Study diagram
Source: (SAVE , 2003)

The pre-workshop preparation stage is performed to organise and plan the value study and thereby accomplish necessary developments such as the concurrence of senior management and the definition of job responsibilities, plans, and roles. The second phase relates to workshop activities and in this phase, the VM is followed by the job plan. Here, multi-disciplinary teams develop action plans with an aim of enhancing project value through analysis functions. The next phase is the information phase, in which current conditions are identified and examined, while the goals of the study are evaluated (SAVE, 2003). The main aim of this phase is to identify the current position of the project, along with its limitations, if any. The information phase must take account of the customer's voice because in the manufacturing sector, the customer's voice is essential because the customer the ultimate user of the product. The function analysis phase is necessary to determine the elimination and improvement needs of plans to ensure that the goals of the project are achievable (Crow, 2002). In the creative phase, different ways of performing the project's functions are identified, while alternative ideas are integrated to ensure the project's success. Sometimes, due to external environmental conditions, it will be decided that the plans cannot be implemented, and if this occurs, an alternative course of action will be implemented.

The evaluation phase makes use of the structured evolution technique, which outlines the scope of value improvements (Male & Steven, 1998), while in the development phase, ideas are developed based on supporting documentation so that the project can be further analysed and its merits converted into value alternatives.

A description of each phase should be prepared properly, and when an alternative course of action is followed, the reasons for this should be made clear to evaluate whether the value alternatives are independent and mutually exclusive. The selected ideas will then be developed into value alternatives to allow the owner and project stakeholders to understand their benefits and disadvantages. Probable negative factors are linked with the alternatives, which will include text, diagrams, sketches, supporting documentation, vendor information, and cost worksheets, along with other relevant documentation. All alternatives that can increase the capabilities of the project should be considered (Abdelghany, Rachwan, Abotaleb, & Albughdadi, 2015). In the presentation phase, a report will be prepared, documented, and presented to the project's senior managers and stakeholders, and it is at this point that the overall suitability of the housing project is evaluated,

and opportunities related to value improvements identified and put into action. This stage provides information to project managers, stakeholders, and decision makers, and enables appropriate ideas to be selected and implemented, which assures the strategic development of the project. The optimum deployment of resources at the right time is necessary at this time to ensure so that all useful opportunities can be seized (Kurita, 2007).

According to Kurita (2007), VM achieves the objectives of a project by selecting the appropriate tools and techniques. Crow (2002) has found that customers will interpret different functions in different ways. Costs are based on projects' performance, style, and design. Karcher (2016) has written that a job plan will fail if engineers do not abide by a customer focus, despite it being a necessary way to achieve customer satisfaction.

2.7 Impact of VE, VM, and value methodology in UAE housing projects

2.7.1 VE in housing projects

VE encompasses the pre-fact analysis and design stages of a project. It is used for new products and aims to apply techniques and principles such as development, design, and prototyping in the pre-manufacturing stages (Chavan, 2013). Overall, it can be said to be a powerful tool that brings about change management, solves problems, and generates breakthroughs by targeting mismanagement during the design phase of housing projects. Value is defined as a cost-to-performance relationship that leads to decreases in costs, increases in value, and maintains essential performance; value can be increased with respect to customers' needs, demand, and willingness to pay (SAVE International Value Standard, 2007).

VE can be implemented in the context of the UAE in a number of ways. Ahmed (2016) conducted a study that looked at the implementation of VE in the process of developing residential buildings in the UAE, and suggested that because its use has been minimal in the region, residents have faced problems such as high electricity and water costs, showing the need for the UAE to promote VE among construction companies (Ahmed, 2016). According to Abdelghany, Rachwan, Abotaleb, & Albughdadi (2015), VE is an important tool for improving the quality of housing projects and introducing cost savings.

Knowledge of VE has led to concerns about the environmental impact of construction projects, and companies have increasingly begun to follow sustainable practices to ensure that the environment is not damaged and greater value is created. VE is necessary in the contemporary world to guarantee that construction projects are sustainable, and even though few large companies strictly abide by sustainability practices, it is likely that in the future, most companies will come to understand their benefits and implement such practices. The adoption of VE can reduce the costs of construction by 20% to 50%, which is sufficient to achieve a large overall reduction in the cost of projects (Abdelghany, Rachwan, Abotaleb, & Albughdadi, 2015).

VE does not seek to reduce the scope of projects, but rather find solutions that meet design requirements at a favourable cost, and provide clients with the most desired value. To achieve this aim, VE is conducted to evaluate the most effective design method to achieve the project goals (Dehmourdi & Ebrahimi, 2014).

VM maintains a balance between the needs and wants of the customer, and promotes sustainable development. VM and VE are two sides of the same coin in that they both promote value for money. VM is used to provide maximum output from limited resources, being an exceptional tool to identify a project's objectives from the client's perspective (Abdelghany, Rachwan, Abotaleb, & Albughdadi, 2015). The VM cycle comprises discovery, optimisation, and realisation, and accelerates the pace of performance.

In the discovery phase, a benchmark is set for performance, success metrics are predefined, and executives are answerable for outcomes, while in the realisation phase, project priorities are identified, the design is developed, and management visibility constructed through the project design. The third phase is optimisation, during which the strengths and weaknesses of the project are discovered, the thinking and ideology outlined, based on a desire to foster performance that assures success, and management discipline and visibility are enabled (SAP, 2015).

2.7.2 Guidelines for improving the value methodology in UAE housing projects

The practice and implementation of a value methodology in social housing and infrastructure procurement has been very successful in the global context. VE has proved to be a promising technique for the development of housing projects, with units being developed that satisfy the needs and expectations of the customer. In the UAE, government housing facilities are not restricted to people with low incomes, but are rather made available to all citizens. According to a report by the UAE government (Chang, Bahar, & Zhao, 2012), end users are frequently not satisfied with ready-made house designs, which often lead to increased costs because shortly after receiving their housing, users need to engage in refurbishment. This being so, end users should be involved in the project in the procurement stage to ensure that houses are built according to their requirements. The alignment and identification of VE techniques is essential. This engineering technique can be treated as a remedial action for a value methodology in a housing project (Hansson, 2015).

VE job plans have been employed to find solutions to research problems because they stress the participation of end users in the workshop, pre-workshop, and presentation phases. It is essential to complete the latter to achieve the desired outcome, while this technique also helps to eliminate unnecessary costs. VE is particularly helpful because it: achieves value for money by fulfilling the requirements of the customer; avoids unnecessary expenditures; perfectly balances function and cost; identifies substitutive materials; examines the design at key points; promotes correct specifications; and enables better conservation of energy. A significant problem in the construction industry is how to strike a balance between attaining the required level of quality and managing expenditures, and to this end, the quality of a housing project can be achieved by following newer models of evaluating costs and determining the optimal levels outcomes. After that, all housing projects in a similar range can be completed within certain determined budgets (Heravi & Jafari, 2014).

Hansson (2015) has looked at the significance of VE for construction in the UAE. VE is used to enhance the satisfaction level of the end user, as well as to reduce costs for the government (Hansson, 2015). Another major problem in the UAE is the absence of sustainability practices in

medium-range housing projects. To overcome this challenge, lean principles are a possible strategic measure that can be used to deliver construction projects that are innovative and sustainable and address issues relating to insufficient quality, low productivity, and cost and time overruns. Lean principles should be integrated into project development plans to deliver projects that offer optimal value to clients.

According to Al-Aomar (2012), in the context of the UAE, lean principle—or a model with a six sigma rating—should be integrated into construction projects to reduce waste. Lean performance management enables organisations to assess the sustainable performance of projects on the basis of key performance indicators at regular time intervals, and thereby measure the progress of a project and suggest further improvements (Al-Aomar, 2012).

In his work, Othman (2008) focused on the integration of the concepts of risk management and VM in low-cost housing projects to allow construction companies to complete projects on time, within defined budgets, and in ways that are appreciated by users. The government should make use of these concepts as it constructs low-cost housing units to analyse the risks associated with such projects, given that the customers of such units will not be able to cover subsequent costs that arise. In this case, customer satisfaction can be attained by involving clients in the design process, analysing the risks from the beginning, taking measures to resolve them, and keeping architects up to date with alternative techniques and methods to ensure maximum satisfaction (Othman, 2008).

According to Hoonakker, Carayon, & Loushine (2010), customer satisfaction is an issue that is of prime importance for companies working on housing projects because the customer is the person for whom products and services are designed and developed. In the construction industry, it is the customer who utilises the final product created by companies and therefore in this industry, both the end user and the client can be considered the customer. Traditional research perspectives tend to be employed in studies of customer satisfaction (Hoonakker, Carayon, & Loushine, 2010), but there are no specific procedures used to determine levels of such satisfaction. Product improvement and customer satisfaction are twin pillars of housing construction, while housing constructors in the UAE tend to subscribe to the belief that it is more important to retain existing

customers than to gain new ones, given the difficulty of entertaining new customer requirements (Hansson, 2015).

2.8 Summary of the literature review of VE and VM

VE, VM, and value methodology are crucial concepts for the UAE construction and housing sectors. The tools and approaches that follow from these concepts enhance the effectiveness of housing and construction projects, and save time as well as the cost of resources. VM is the means by which to improve the effectiveness of housing and construction projects. This literature review chapter has sought to show the relevance of the concepts of VE in the context of construction projects based in the UAE, and highlight the flaws in domestic housing projects such as the lack of sustainability, project delays, and time and cost overruns. Finally, a study of the academic literature has provided the means to resolve these issues in the context of the UAE. The literature makes it clear that a strict implementation of VM, risk management measures, and lean management practices are some of the productive steps that can be taken in this regard.

CHAPTER 3 – Housing in the UAE

3.1 Introduction

This chapter aims to understand the culture, economy, and social considerations of the UAE that impact the construction of residential housing. The chapter identifies various housing concepts that are linked to the culture and social life of the UAE, and is divided into six sections.

The first section provides an introduction to the chapter, while the second deals with the background of the country and explores aspects such as its history, geography, environment, and climatic conditions. This section also throws light on the background of housing in the UAE. The third section deals with the various housing programmes that have been initiated by the UAE government over the years to boost the amount of available residential housing such as the Sheikh Zayed, Sheikh Mohammed, and Emirati housing programmes, which are analysed in detail in order to understand their significance. The fourth section deals with private-sector housing projects, analysing the role played by giant developers such as Emaar, Sorouh, and Aldar in the development of residential housing projects. The fifth identifies the requirements of homeowners in the UAE, looking particularly at the needs of UAE clients seeking to purchase a residential property in order to help the government to formulate residential projects and strategies. The final section summarises the entire chapter.

3.2 Background of the UAE as a country

3.2.1 History

In the 19th and mid-20th centuries, the main source of income and employment for the people living the Gulf was the pearling industry. However, the industry experienced a significant setback during the great depression of the late 1920s and early 1930s, in tandem with the invention of the cultured pearl by the Japanese (Ibp Inc, 2013).

Britain decided to withdraw from the Arabian Gulf at the end of 1971, at which point Sheikh Zayed moved rapidly to establish strong and closer ties between the various emirates. On 2 December 1971, an agreement was negotiated between six emirate rulers to unite into one federation, which

was named the United Arab Emirates, or the UAE. The six emirates were Sharjah, Abu Dhabi, Fujairah, Dubai, Ajman, and Umm al-Qaiwain, while a seventh emirate formally acceded to the federation on 10 February 1972. Sheikh Zayed remained the president of the UAE until November 2004, taking care of various aspects of the federation until his death. A provisional constitution was drafted and accepted by all seven emirates, and then developed to achieve certain objectives and a common good for the entirety of the UAE.

The political development of the UAE began as a federation of seven emirates that have different cultures, sizes, populations, natural resources, heritage, and wealth, but a common history. Abu Dhabi has the largest amount of natural resources, while Dubai has seen tremendous growth in recent decades, becoming the commercial hub of the entire region. The economy of the UAE has been highly dependent on oil and related resources, but in the light of advancements and developments in the global economy in general and the UAE in particular, the government at the national and regional levels has considered boosting other sectors of the economy (Sheikh Mohammed, 2015).

3.2.2 Geography

Figure 3.1 depicts the strategic geographic location of the UAE within the Arabian Peninsula. The country borders Saudi Arabia to the south and Oman to the east (Dynamic Personnel, 2015).

All of the emirates that make up the UAE are situated on the Arabian Gulf opposite Iran, and share a coastline that covers a distance of around 404 miles, with the exception of the Emirate of Fujairah, which looks out onto the Gulf of Oman. The federation covers a total area of approximately 32,300 square miles or 83,600 square kilometres, as evidenced in Table 3.1. A total of 87% of the land mass belongs to the Emirate of Abu Dhabi, making it the largest emirate in terms of land (Columbus Travel Media, 2015).

Figure 3.1: Geography of the UAE
Source: (Dynamic Personnel, 2015)

Table 3.1: State-wise area of the UAE
(Image source: http://www.fao.org/nr/water/aquastat/countries_regions/ARE/Table_2.png)

Mainland area and farms by Emirates				
Emirate	**Mainland area (excluding islands)**		**Farms in 2003**	
	Area (KM)	**%**	**Number**	**Area (ha)**
Abu Dhabi	**67,340**	**86.7**	**22,985**	**218,590**
Dubai	**3,885**	**5.0**	**1,326**	**6,176**
Sharjah	**2,590**	**3.3**	**4,392**	**13,275**
Ras al Khaimah	**1,683.5**	**2.2**	**4,465**	**13,571**
Fujairah	**1,165.5**	**1.5**	**4,346**	**5,324**
Umm al Qaiwain	**777**	**1.0**	**343**	**1,693**
Ajman	**259**	**0.3**	**691**	**2,104**
Total	**77,700**	**100**	**38,548**	**260,732**

The UAE is home to marine coastal areas, mountain areas, and deserts. A total of 80% of the land mass is desert. The country has an arid climate, of which only 3.8% is woodland and forest. There are three main geographical zones in the UAE: low-lying and flat, barren coastal plains; sand dunes

that stretch from the coast to the wastelands, making the UAE the largest sand desert in the world; and a rugged mountain range that extends into Oman in the northeast. Most of the mountains are bare and only some have vegetation. The highest point in the UAE is 1,527 metres above sea level, and is known as Jabal Yibir (Fanack, 2015).

The UAE enjoys a strategic location between the Far East and Europe, and attracts traders from China and India. Historically, the territory has been prized by many Europeans, particularly the British, Dutch, and Portuguese. The location of the country also makes it accessible from Asia, Africa, and Europe, which has allowed it to develop into a trading hub. For almost a century leading up to 1968, the UK ruled the Gulf based on peace treaties in which it promised to protect the emirates from foreign aggressors.

In 1968, the treaty was dissolved, which led to the formation of UAE. However, at that time, the borders of the UAE were not clearly demarcated, and there were several disputes with Saudi Arabia. In 1974, the Jeddah Treaty was signed between the states in order to delineate the border between the two countries, but the treaty failed to resolve the main issue at stake. The border with Oman remained unsettled until May 1999, when the UAE constructed a fence along the entire border (Fanack, 2015).

3.2.3 Environment and climate

The UAE has blue skies and sunshine all year, with very little rain. It has become a global tourist destination mainly because of the climate; many sun-seekers are drawn to the UAE, and it has become a prominent tourist destination. Figure 3.2 shows that between October and April, the country's climate is pleasant and the temperature hovers between 25ºC and 28ºC (Weather-and-climate, 2020), but from June to September, the heat is unbearable, and residents have to deal with humidity and high temperatures. Wind and rain are only likely to occur in January (Columbus Travel Media, 2015).

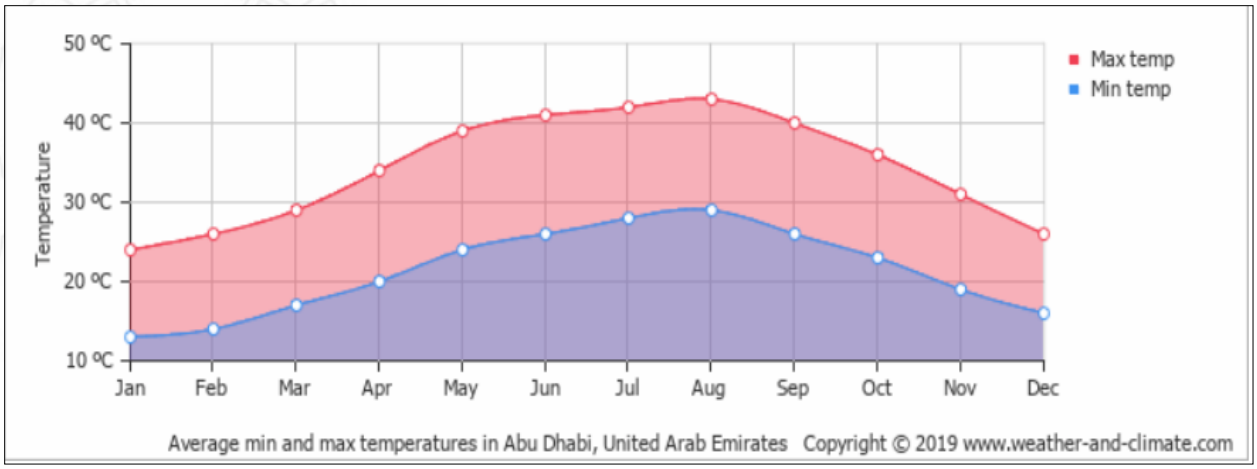

Figure 3.2: The UAE climate
Source: (Weather-and-climate, 2020)

The UAE's location within the northern desert belt of the Arabian Peninsula means that it is known for its scarce and unpredictable rainfall, soaring high temperatures, and exhausting humidity, accompanied by the prolonged duration of sunshine. The climate of the UAE desert leads to harsh conditions; the country is generally humid and hot during the summer and comparatively cooler in the mountainous regions. The easterly or *sharqi* wind, a humid southeast wind that occurs during the late summer, means that the climate during this time of year is humid; however, this is accompanied by a slight drop in the temperature in the evenings.

The UAE also manifests the characteristics of the wider region, and is thus prone to dust storms and the occasional violent sandstorm. These storms are caused by the *shamal* or strong north-westerly and northerly winds, which have a reputation of affecting health, being hazardous, reducing visibility, affecting traffic, and being disruptive to overall lifestyles (Fanack, 2015).

Most tourists visit the UAE from October to April. However, the country's excellent infrastructure makes the climate easy to bear, even during the months of September to March. The residents of the UAE enjoy all aspects of the climate and have their own ways of tackling the extreme conditions. The government and residents have worked to improve the environment by building green areas such as parks and gardens, which are well maintained by the local community.

The concept of the environmental renaissance arrived only recently in the UAE. This concept is intended to increase environmental awareness and create a sense of mutual obligation to the natural resources in the sensitive environment of the Gulf. Such campaigns are not only run by the government, but also by non-governmental groups that promote environmental concerns. There is a clear sense of conviction shared by the various federal bodies, non-governmental organisations, and individual agencies that work in alliance with international and domestic counterparts to create a sense of protecting and safeguarding the environment (Aspinall, 2014).

3.2.4 Housing background

Houses in the Islamic-Arab region are traditionally expected to convey a sense of beauty and, most importantly, structural clarity. Such houses are based on plans that have been drawn up with the objective of providing order and form to the space within, and ensuring the measurement and scaling of the human body to ensure an enhanced living experience. The development of houses in the Islamic-Arab region was based on certain sustainability-orientated principles; the traditions and habits of local have dictated the spaces and forms of houses. The conceptual designs of Islamic-Arab houses, along with problems and their solutions, can largely be traced to ancient Arab architecture, much of which still exists to date (El-Shorbagy, 2010).

During the pre-oil era, which lasted until the late 1950s, there was no concept of formal housing in the region, and no provisions for housing existed in government policies; any type of formal housing that existed was solely due to individual efforts. Figure 3.3 shows a typical UAE house from the 1950s. The main problem with housing at that time was the scarcity of resources, due to which rulers were unable enact provisions for housing. The houses of local people tended to be built of date and palm products, while the houses of richer and ruling families were made of imported wood, mud bricks, and coral stone.

Figure 3.3: Typical UAE houses in the 1950s

Source: (Media Tumbler, 2016)

Changes first came about at the beginning of the 1960s, when oil revenues began to increase significantly, supporting the government as well as individuals. At this time, local governments took steps to ensure development and regulated town planning by establishing municipal institutions. Dubai was the first emirate to set up a municipal council in 1957 to develop building regulations and institute planning. As the economy advanced and economic conditions improved, the government began to work together with foreign consultancies to ensure regulated planning and building for housing in the UAE. Figure 3.4 shows the evolution of UAE housing over time. Houses made of date palms were replaced by those of cement and sand blocks known as 'Arabic houses' (Al-Mansoori, 1997).

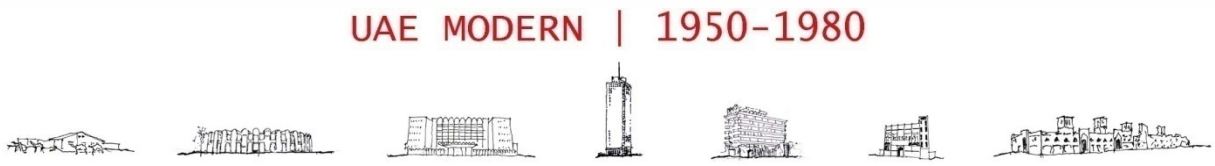

Figure 3.4: Evolution of UAE housing over time

Source: (Media Tumbler, 2016)

The government has played an important role in supporting housing programmes by appointing foreign consultants in newly established housing departments, which otherwise were staffed by local people who lacked the qualifications and expertise to run such departments. The government

employed engineers and architects from Egypt, Europe, Jordan, and Sudan to ensure proper planning and well laid out towns and municipalities.

3.3 Modern government housing programmes

3.3.1 The Sheikh Zayed programme

The Sheikh Zayed housing programme was initiated in 1999 with the objective of providing suitable housing facilities for UAE families to meet the aspiration of the government to provide a high standard of living for all citizens. Figure 3.5 shows how houses have developed in the Sheikh Zayed programme, according to which houses can be claimed by UAE nationals who are unable to offer suitable housing for their families and who have not received any type of grant or housing aid from any government authority since 2000. Furthermore, the person claiming services under this programme must be the family breadwinner, and it must be established that his sum total of assets and income cannot assure or buy him a good house (Abu Dhabi Government, 2015).

Figure 3.5: Housing under the Sheikh Zayed programme

Source: (UAE Interact, 2015)

Vision of the programme

The vision of the programme is to bring about pioneering and exceptional partnerships within the community, with the objective of achieving stable and adequate housing facilities for UAE nationals (Abu Dhabi Government, 2015).

Mission of the programme

The mission of the programme is to provide suitable and adequate housing facilities for UAE national families by way of strengthened cooperation with partners. Furthermore, the mission aims to develop and procure better human and financial resources through creative media and provide exceptional services through a workforce that is qualified, experienced, and skilled, along with the integration of advanced electronic systems (Abu Dhabi Government, 2015).

Objectives of the programme

- To ensure diversification of resources to suit the mission of the programme;
- To increase the number of sanctions and approvals granted to housing programmes and improve housing transactions;
- To attract qualified and experienced personnel for the purpose of continued development by investing in qualifications;
- To enhance coordination and teamwork between various sectors related to the programme so that the effectiveness and quality of projects can be increased; and
- To develop methodologies and mechanisms for working and upgrading services and facilities (Abu Dhabi Government, 2015).

Services offered under the programme

To fulfil the above objectives, the programme offers the following set of services (Abu Dhabi, 2015):

- **Grant**: a non-refundable grant for the purpose of building a new house or buying, carrying out expansion on, or performing maintenance on a house, and purchasing or building another house, as per the requirements of the family.
- **Loan**: these are provided without interest, for the purpose of building a new house or buying, carrying out expansion on, maintaining or renovating a house, and purchasing or

building a house other than a residential house for the requirements and circumstances of the family.

- **Government housing**: under this service, UAE nationals are provided with houses either as separate residential units or within residential compounds. Such houses are built by the government and given to the beneficiary after completion (Abu Dhabi Government, 2015).

Use of the programme and money spent

In 2020, the Sheikh Zayed Housing Programme approved AED 395 million to help 503 citizens to purchase residences in the form of housing loans and grants, while in 2019, a grant of Dh 410 million was approved to meet the needs of 522 housing assistance applications made by Emiratis (Gulfnews.com, 2019). These financial outlays reveal the extent to which the UAE government ensures the wellbeing of its citizens, such as by securing permanent residences for them (Emirates247.com, 2020).

Advantages and disadvantage of the housing programme

There are a number of benefits to this housing programme, the chief of which is that it offers many Emirati citizens a suitable residence that is connected to a modern infrastructure. This government housing is located within residential complexes and comes at a reasonable cost, the latter decision having been made to relieve Emiratis of potential financial burdens (ADGECO, 2017). The houses developed under the auspices of the programme are highly customer-oriented and include various features designed to provide a desired level of comfort to customers.

However, there are also certain disadvantages to the programme. The houses are all similarly designed, and can only later be modified at the customers' expense. Furthermore, many of these residences are very close to busy highways, where traffic and other disturbances reduce the quality of life of those who live nearby. Another issue is that many customers have complained that the designs of the houses are poor and the materials used in the construction are ineffective. However, it can be stated that the advantages associated with living in residences provided under the auspices of this programme outweigh the disadvantages (Bayut, 2020).

3.3.2 Sheikh Mohammed programme

The Sheikh Mohammed programme, formally known as the Mohammed Bin Rashid Housing Establishment (MBRHE), was initiated by the government in 1999 and is run as a corporate partnership designed to provide adequate and appropriate buildings for the housing of UAE nationals living in the Emirate of Dubai. The housing facilities offered in this programme are shown in Figure 3.6. Under the MBRHE, a range of services related to housing requirements are provided under a single umbrella encompassing government housing, residential plots, ready-to-move-in houses, housing loans at zero or low interest rates, and maintenance and extensions for current housing schemes. The aim of the programme is to stimulate economic growth by implementing investment projects and executing strategic partnerships between the public and private sectors (Mohammed, 2015).

Figure 3.6: Housing under the MBRHE

Source: (MBRHE, 2019)

Tasks under the MBRHE

The main intention of the programme is to build, develop, and execute the housing strategy of the Emirate of Dubai, and issue such legislation as is considered necessary to implement the above, thereby supporting the vision of the Emirate of Dubai to boost growth and development (MBRHE, 2019).

Other tasks include

Another task is the development of an integrated system of reference databases to connect houses within the emirate to promote efficient housing policies. Doing so will also support the analysis of future needs and housing requirements. The MBRHE is also tasked with producing social,

environmental, and housing studies to better understand future needs and requirements, and thereby extend necessary services and support to the areas concerned and ensure that developments trend in the planned direction (MBRHE, 2019).

To meet its objectives, the MBRHE also grants gifts of housing to certain persons who are deemed to be deserving due to a limited income, as well as various housing loans through which new houses can be purchased from either a third party or a company. Loans are sanctioned for to those who wish to build a new house or extend an already built one, as per the standards and conditions mentioned of the MBRHE. The terms of the MBRHE ensures that the design and execution of housing projects strictly conform to approved standards, and that there is no compromise in terms of the quality of the raw materials used. The programme aims to redevelop rural, desert, and urban areas, as well as to promote areas that are environmentally, economically, and socially left behind (MBRHE, 2019).

Use of the programme and money spent

The MBRHE has launched projects in a number of locations across the country, with the ultimate aim of building tens of thousands of units. Sheikh Mohammad personally approved the housing projects, which have a total cost of AED 3.6 billion, in the form of extensive loans (Bhatia, 2015).

Advantages and disadvantages of the housing programme

One advantage of the programme is that citizens receive loans and financial aid to purchase a suitable home, and thereby are given access to ready-made houses that come with a maintenance guarantee (Dubai, 2016). The programme provides basic amenities to a large number of citizens and enhances the overall standard of living within the country, in addition to the soft loans from local banks or government agencies to which citizens have access.

However, although such offers are well-intended, they have given rise to a number of unintended consequences. Poor workmanship by construction companies has led to many construction defects that have affected the quality of buildings (Othman, 2005), while another problem is that the MBRHE has focused on the construction of small villas, despite many people's preference for larger apartments. This represents a major shift in the preferences of Emirati people, and is a

significant reason for the scepticism that exists with regard to the programme. Yet another disadvantage is the unstructured access to home financing that has come about due to an underdeveloped financial market and strict regulations.

3.3.3 Emirati housing programme

The Emirati housing programme was initiated by the Abu Dhabi government in 1999, in line with the Sheikh Zayed housing programme. It is an ambitious housing programme that aims to establish a model for the entire region in terms of unique and sustainable urban development. Figure 3.7 shows the houses being constructed under this scheme.

Since 2006, the Abu Dhabi government has followed a modern approach towards its citizens in terms of the development of housing-based community systems that are integrated and able to replace the traditional system of *Sha'biya*.

Figure 3.7: Housing under the Emirati housing programme

Source: (Abu Dhabi Government, 2014)

The government has begun to give increased consideration to the concepts of social cohesion and family stability, and has thus started to fund projects relating to citizen housing and infrastructure. Thanks to boosts in funding, more residential housing units are available, and the Abu Dhabi government has developed a variety of housing options including residential plots, ready-to-move-

in houses in integrated villa communities, and interest-free loans. This background shows the importance of infrastructure and residential housing to the UAE government, which has for some time dedicated itself to the societal needs of its citizens, and is determined to ensure that all citizens have access to suitable and adequate housing facilities that they can enjoy with their families.

Use of the programme and money spent

In 2011, the Abu Dhabi Urban Planning Commission (UPC) signed agreements with major players and real estate developers within the emirate to build at least 7,500 homes in the city of Abu Dhabi, the city of Al Ain, and the emirate's western region at an approximate cost of AED 13.5 billion. When the programme was first implemented, the government voiced its intention to build 15,000 houses by the end of 2015 (Abu Dhabi Government, 2014).

Advantages and disadvantage of the housing programme

The main advantage of this programme is that it supports sustainable development and meets the residential needs of citizens. The programme is designed to ensure the safety and security of consumers and maintain the housing authority's management system. The communities constructed under the Emirati housing programme are provided with facilities such as mosques, schools, women's centres, and a wide range of retail outlets, meaning that people they are not required to travel far for shopping and work. A major disadvantage of the programme is the lack of focus on VM techniques that emphasise gaining value for money. The second disadvantage is high design fees charged by firms that are not commensurate with low-income housing projects. In addition, the life cycle of the project was not considered in the beginning, while the programme is limited in terms of the types of assistance it is able to offer. For example, it offers either direct financial, land, or housing units, which has generated a mismatch between assistance and need. Most schemes require beneficiaries to repay the value of the benefit over time, even though in some circumstances, the buyer's income will not allow them to become a homeowner, leading to a denial of assistance (Bohsali, Sfeir, Abdallah, & Wehbe, 2014).

3.4 Private-sector housing projects

3.4.1 Emaar

The business strategy of Emaar is to replicate its Dubai business model and practices in international markets, while leveraging execution competencies and capabilities to ensure efficient management, distribution, and project sales (Molotch & Ponzini, 2019). The strategy in place at Emaar limits funding from the parent company to construction related to initial infrastructure and land acquisition. The company raises additional funding at the project level by way of pre-sales, initial public offerings (IPOs), and project-based debt financing. Emaar aims to develop new and better iconic projects in Dubai, given the current buoyancy of the real estate sector.

Product sale competencies at Emaar are strengthened through the firm's global market reach, joint ventures, and the implementation of best practices for working via strategic acquisitions. In order to build residential houses with greater capabilities and advanced facilities, Emaar has acquired skills from various foreign partners to ensure innovation in terms of products and to maintain its global competitiveness. With such strategic policies, Emaar was able to hand over approximately 21,000 residential units to customers between 2001 and 2007. Emaar's initiatives towards the development of residential houses are in line with various housing strategies implemented by the government. Emaar has been able to help the government by delivering residential houses of excellent quality and equipped with world-class facilities, thereby extending its support to achieve the objectives set by the government under the various housing schemes (TAIB, 2014). Figure 3.8 shows the houses constructed under this program.

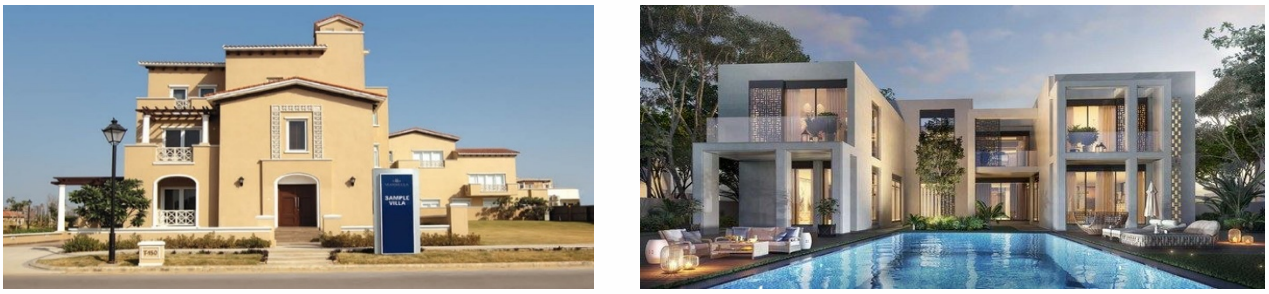

Figure 3.8: Housing under the Emaar housing programme

Source: (TAIB, 2014)

Through its various residential housing projects, the company ensures that it considers the needs of people from various segments of society. Houses are offered at various rates, according to the facilities with which they are equipped (TAIB, 2014).

Use of the Emaar programme and money spent

Emaar Properties is the largest publicly listed property development company in the Middle East and North Africa (MENA) region. According to data from 2014, the company had a market capital of US $19.40 billion, while since 2001, it has delivered more than 37,500 residential units to customers in the UAE (EMAAR, 2014).

Advantages and disadvantage of the Emaar housing programme

Various projects are integrated within communities and offer luxurious villas with swimming pools, gyms, and other modern facilities. Emaar ensures that the quality of its projects is never sacrificed at any level, and it has become known for delivering high-quality end products (TAIB, 2014). However, because the firm delivers world-class facilities, housing units are very costly.

3.4.2 Sorouh

Sorouh is the second-largest real estate developer in Abu Dhabi. Since the decision was made by the government to allow non-citizens to invest in the UAE's real estate and infrastructure sector, the company has made substantial profits. Sorouh is considered a master developer in the region, and has recently launched a unit in Dubai that will ensure the efficient utilisation of overseas acquisitions by setting up contracts with companies in Morocco and Egypt to initiate residential and commercial projects (Arabian Business, 2015).

Sorouh was established in 2005, and has grown rapidly since then. The main objective of the company is to develop real estate projects in Abu Dhabi, based on an overall vision of turning Abu Dhabi into a major tourist destination. Residential housing projects form an essential part of the company's development strategy. Given the growth in population and subsequent requirements for housing, in tandem with the support it receives from the government to build and develop residential housing of various types, Sorouh aims to develop houses that suit people of various income groups. The company has obtained approval for many residential community projects that

will provide housing facilities to families in the UAE, and the company ensures that the products it delivers are of high quality and able to compete with rival developments. Figure 3.9 shows the residences constructed by the company.

Figure 3.9: Housing under the Sorouh housing programme

Image Source: (Construction Week Online, 2016)

One major residential development project undertaken and initiated by Sorouh is the Watani Residential Development, a unique living place for local people that consists of a range of accommodation in family-orientated neighbourhoods (PMDC, 2011).

Use of the programme and money spent

The project intends to deliver a total of 1,370 villas that will have four to five bedrooms and offer a range of facilities that meet international standards and suit the needs of Emirati families. The villas were built under the auspices of the Watani project at a cost of DH 5.4 billion (Bundhun, 2012).

Advantages and disadvantage of the housing programme

An advantage is that the entire community includes mosques, community centres, a British international school, and sporting facilities (Bundhun, 2012), but a significant drawback is that it is not affordable for low-income people.

3.4.3 Aldar

Aldar Properties is an Abu Dhabi-based real estate developer and one of the largest in the MENA region, controlling assets worth US$ 12 billion. Aldar was established in 2004 and has since then been involved in a range of Abu Dhabi-based initiatives to ensure the development and growth of the emirate's infrastructure and real estate sector. It has overseen complex and iconic projects, including the development of Formula 1 facilities on Yas Island and the thriving and ambitious Shams Abu Dhabi community on Reem Island. The company's portfolio is diversified yet balanced, with projects relating to residential community building accounting for more than half of its total assets and retail property projects accounting for a third, with the remaining portion split between the hospitality and commercial sectors. The main aim of Aldar Properties is to serve the growing needs and demands of UAE citizens by providing high-quality properties that are professionally managed for their benefit and comfort. The Abu Dhabi government is a major shareholder of the company and evinces this strong partnership in all the company's projects. The business practice is aligned with Vision 2030, which is a long-term economic vision of Abu Dhabi proposed by the Abu Dhabi Council for Economic Development and the Department of Planning and Economy that seeks to develop the emirate's social infrastructure and promote economic diversification (Aldar, 2015). Figure 3.10 shows the affordable houses developed by Aldar properties.

Figure 3.10: Housing under the Aldar housing programme

Source: (The National, 2015)

The company is heavily involved in developing and delivering various projects that employ expertise in planning and blend traditional and modern styles of community living. The company's residential housing projects consist of a blend of international and national styles, featuring modern

facilities and services. Many residential projects are undertaken by Aldar. Approximately 7,500 homes will be offered at Reem Island, and 2,000 new homes will be made available in the future to bridge the shortage of houses. Various national housing projects undertaken and developed by the company in the course of its residential housing programme include Al Falah, Sheibat Al Watah, Ghuraibah, Watani, and Sila'a.

Use of the programme and money spent

In November 2019, Aldar Developers announced the Saadiyat Grove Scheme. It cost a total of Dh 8 billion, is located near the cultural district on Saadiyat Island, and includes 3,706 residential units, along with thousands of squares metres made available for retail, entertainment, and other purposes. The first phase of this project will construct 606 residential and 200 retail units, which are planned to be delivered by 2022. Developers have so far begun to sell 306 plots at a starting price of Dh 1.6 million (Rahman, 2019). The government of Abu Dhabi has collaborated with Aldar Developers to ensure good-quality infrastructure and housing.

Advantages and disadvantages of the housing programme

Under this scheme, housing prices are kept low in comparison to market prices in order to cater to the needs of teachers, nurses, and people working in the oil and gas sector, all of whom are offered certain discounts (Barnard, 2013). Properties are available on Saadiyat Island, Yas Island, and Al Falah, which are close to flourishing residential communities and commercial destinations in the region. However, one disadvantage is that given the locations, the residences are very expensive, and most people on a lower salary are unable to afford them (Emirates247, 2019). These units are only available to wealthy people able to afford high-end infrastructure and facilities.

3.4.4 Disadvantages of existing housing programmes

The existing housing programmes build by public- as well as private-sector companies have various disadvantages, one of which is the similarity in designs of houses provided under the Sheikh Zayed housing programme, which need to be modified by customers if they wish to create a personalised residence. Furthermore, these residences are very close to a busy highway where traffic conditions and pollution reduce the quality of life of residents. Furthermore, the houses are poorly designed with low-grade building materials. Despite this, it can be stated that the

advantages associated with living in residences provided under the programme outweigh the disadvantages (Bayut, 2020). The houses built under auspices of the MBHRE project regularly suffer from the poor workmanship practiced by construction companies that results in construction defects in buildings. Furthermore, the project largely consisted of small villas, despite most citizens' desire for larger apartments, which reveals a major shift in the Emiratis' preferences, and is the main reason for the lack of interest in the housing produced by the MBHRE project. The unstructured access to home financing that has accompanied the programme due to the underdeveloped financial market and strict regulations has also been deleterious. The Emirati housing programme did not abide by any VM techniques, which emphasise maximising value for money, while the contracted firms charged high design fees that were not proportionate for such a low-income housing programme. Another drawback is that the programme is limited in terms of the assistance on offer; the programme makes available either direct financial aid, land, or housing units, which has caused a mismatch between assistance and need. The fact that beneficiaries are required to repay the value of the benefit over time means that in some circumstances, a buyer's low income will prevent them from being able to take advantage of the promised housing assistance (Bohsali, Sfeir, Abdallah, & Wehbe, 2014).

The housing facilities offered under private sector housing programmes like Sorouh tend to be extremely expensive, featuring facilities and luxuries that are beyond the financial reach of low-income people. Companies such as Aldar offer housing facilities at comparatively low costs, but residences in upmarket locations such as Saadiyat Island, Yas Island, and the Al Falah region are prohibitively expensive. Both the private- and public-sector companies that offer housing facilities to Emiratis do not operate at a high-quality international level, showing the need for studies such as the present paper that examine how to improve the provision of housing in the UAE.

Overall, it can be said found VM and VE are rarely employed in the various projects undertaken by housing developers in the UAE, revealing the need for a change of direction in this regard.

3.5 Requirements of homeowners in the UAE

There are both rich and poor citizens in the UAE. The country's economy has developed rapidly since it has begun to extract and export its oil resources, but that economy has become highly dependent on oil. The government has sought to develop the real estate and housing sectors by means of the revenues earned from oil, leading to a revolution in the region's infrastructure in the late 1990s. The UAE government ushered in many infrastructure and real estate megaprojects; for example, the country is now home to the tallest building in the world. The residential sector has been supported by government initiatives in the form of housing schemes to ensure the growth and development of residential structures, but it must be borne in mind that there are certain requirements from the point of view of homeowners that must be considered in any residential housing programme (Al-Mansoori, 1997).

1. Tenure security

   Homeowners, and particularly those on low incomes, tend to be very concerned about tenure security. This being so, houses should not be allocated for short tenures but rather should be given to people for life-long occupancy. Such tenure security means that the occupancy of a residential property is secured and protected by the government; families should not be asked to leave the property or move to another at frequent intervals.

2. Structural stability

   This concept refers to the building structure, which should be capable of surviving harsh weather conditions or small tremors that occur during natural calamities. Structures should not be weak or made from low-quality products in order to save costs. This applies to all homeowners, irrespective of the income group to which they belong. High-income homeowners expect structures to be not only stable but also high-quality, and constructed based on a consideration of new housing designs and structures.

3. Infrastructure support

   Houses should be located in areas that are well connected to public routes, buses, and other transportation and communication channels, while they should also be close to or contain infrastructure options such as green spaces and parking facilities.

4. Convenient access to employment

   This aspect is a very important consideration. Emiratis generally prefer to live somewhere that is well connected to employment areas. A house that is situated at a distance or in a location that is not capable of offering employment opportunities will fail to meet most homeowners' requirements, and will therefore be rejected (Othman, 2005).

5. Community services and facilities

   It is important to consider various aspects of social living when developing residential houses. Houses should be located near basic facilities and community service centres. A community can be said to consist of a number of residential houses with access to a mosque, gardens, sports facilities, gyms, and leisure facilities such as swimming pools. All these services and amenities will serve to ensure that homeowner are able to enjoy living in the vicinity of neighbours and services that they might require on a daily basis (Othman, 2008).

The UAE government should develop plans in tandem with major private development firms that take account of the above requirements. This will help to ensure high levels of loyalty towards the government from residents, and ensure contentment with living arrangements.

All facilities and services demanded by UAE citizens can be made available with the help of VE and VM. Homeowners seek to maximise the value they receive from their houses (De Leeuw, 2006), while an important benefit for the government is to reduce the cost of construction and maintenance by following the principles of VE and VM. In this way, a better infrastructure can be made available. VE will help to expedite the improvement of housing projects, and VM to enhance the value of projects (Davis, 2018).

3.6 UAE culture and its impact on housing programmes

Housing projects in the UAE are significantly affected by the country's culture. People in the UAE tend to be devoted to following the traditions and beliefs of Islam, and these principles are adhered to in the process of residential construction. Most UAE citizens prefer to live in modern houses with contemporary designs, but eschew excessive decoration and accessories, preferring an asymmetric balance between furniture and layout. The use of glass is very popular, which incurs

significant construction costs, and means that the exteriors of most houses in the UAE are dominated by concrete and glass.

The interiors of houses in the UAE tend to be modern, while most people prefer to live remotely close to their wider families. Another factor is that most people like to live close to their place of employment, meaning that infrastructure is an important consideration, such as proximity to transportation facilities and communication channels. Many people also prefer their family home to be close to a hospital, in case of a natural disaster or a family healthcare emergency.

3.7 Change management in construction projects

Mid-project alterations are a natural part of the construction process. During construction, many decisions need to be taken based on incomplete assumptions, personal experiences, and new information, and in the case of construction projects, change is the common denominator, although the size, complexity, and scope of the project might differ from one project to another. The endeavours required to address the need for such changes have imposed significant burdens on project management such as cost overruns, project delays, defects, and failures. Many of the changes that occur in construction projects negatively impact the construction industry, showing the need for effective change management. Real estate experts would do well to follow international standards as they seek to manage changes in the construction industry (Hao, 2008), such as by abiding by the following steps:

- Identify
- Evaluate and propose
- Approve
- Implement
- Review

Before appropriate solutions to challenges can be proposed and approved, it is necessary to identify the challenges at stake and evaluate potential avenues for action. The final steps in this process are the implementation and reviewing of what has taken place.

Following these steps can help to manage change in the construction industry. It is very challenging to implement an effective change management system (Hao, 2008) because housing construction entails highly complex projects that make use of a large number of human and other resources, revealing the need for effective project management. To address the various challenges that arise in such projects, effective change management strategies are of the essence.

3.8 Procurement process in housing

The process of housing procurement is long and complex. It is necessary to involve a range of housing authorities in the procurement process, as shown in Figure 3.11, which was developed on the basis of data collected from people and organisations involved in UAE housing programmes such as project managers, consultants, and other government authorities. Secondary data relating to procurement from government organisations was also reviewed to develop a detailed analysis of the procurement process.

The purchase of a house is carried out on the basis of an individual's income and social status. The customer is granted a loan from a financial authority after receiving approval for procurement, while the housing authority maintains and utilises the land resources. Such housing must abide by a suite of procurement principles to ensure that procurement and contract management activities are conducted in an effective, impartial, accountable, fair, and ethical manner in order to protect housing and associated personnel from bias or illicit intentions. The procuring authorities should also ensure that all decisions that relate to procurement are based on achieving effective 'value for money' outcomes. Suppliers should be provided with fair and equitable access to business opportunities, and exhibit transparency and integrity.

Another factor is that housing developers must be committed to ensuring that houses are protected from environmental impacts, while operations are conducted in a socially, financially, and environmentally responsible manner (Government of Western Australia, 2017).

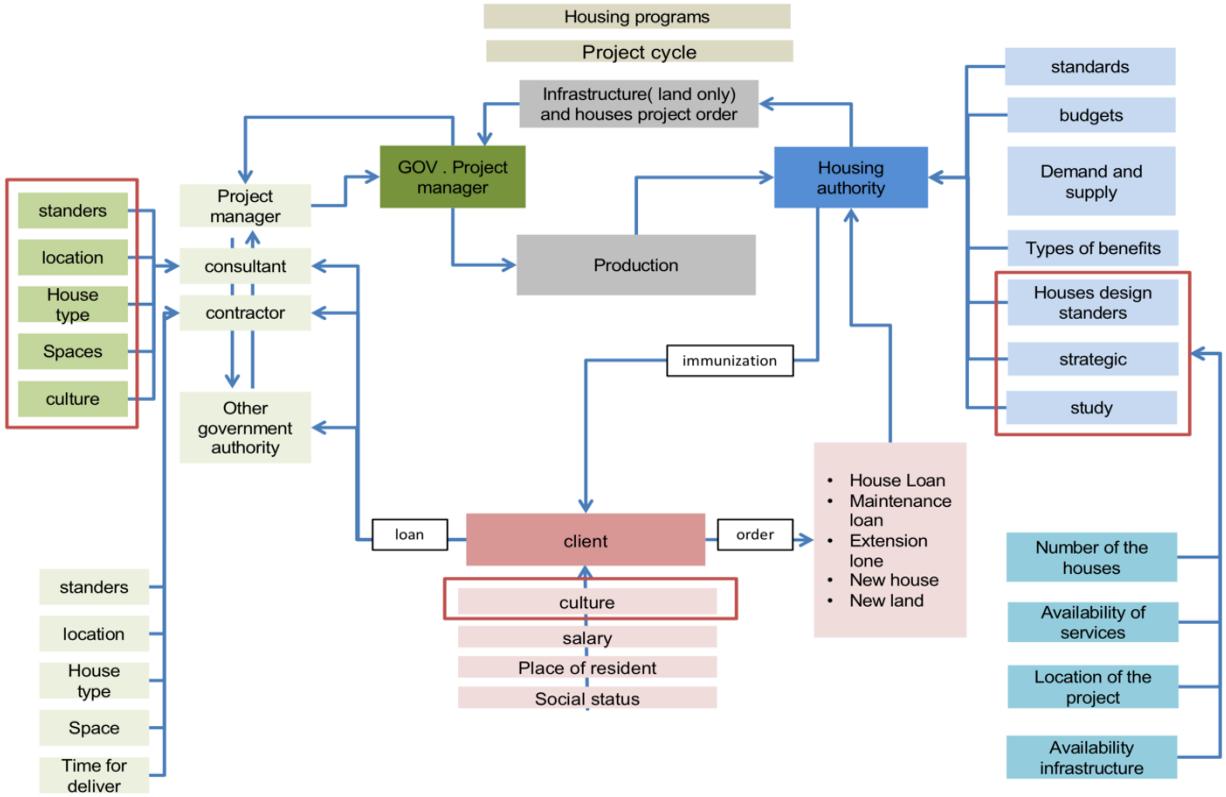

Figure 3.11: Housing procurement process

Source: Housing Authority Abu Dhabi

3.9 Summary of Chapter 3

This chapter has discussed factors relating to the values, culture, and society of the UAE that affect residential housing development projects. The development of government-led residential housing projects in the UAE began in the year 2000, following four decades of oil-driven economic growth; previously, most local residents lived in traditional *Sha'biya* dwellings. Since then, the government has fully supported and funded the country's housing sector and today, it is one of the most advanced in the world. Private real estate developers in the UAE have become major players in the global context, and are highly sought after for the products and services they provide. Local residential housing projects have witnessed the integration of the latest technological advancements, and the most ambitious projects rest on a principle of innovation.

Because many residence are granted to the citizenry under various government housing schemes, even low-income families are able to secure homes that offer basic facilities and amenities. Houses in the UAE are made in a manner that takes account of the country's hot and humid climate to ensure maximum comfort for citizens. The government and private players consider the requirements of homeowners to be a priority, and set great store by ensuring that citizens are happy with their residences.

CHAPTER 4 – INTERNATIONAL PERSPECTIVES ON SOCIAL HOUSING

4.1 Introduction to Chapter 4

This chapter seeks to understand and analyse international perspectives on social housing. The concept refers to the provision of housing facilities to citizens who are unable to buy houses on their own, or who are living in extremely poor conditions. Most developed and developing countries have implemented social housing.

The chapter is divided into nine sections. The first outlines the chapter. The second discusses the notion of affordable housing in general, while the third addresses housing strategies in the UK and analyses the affordable housing, housing policies, and future housing needs in the country. The fourth section deals with Malaysian housing, analysing patterns of urbanisation, the concept of sustainable development, and assessments of housing policies and strategies. The fifth section discusses the affordable housing in the US, while the sixth section looks at the same issue in GCC counties. The seventh section discusses the concept of best value in housing and details aspects in this regard in the UK, Malaysia, the US, and GCC countries. The eighth section compares the housing strategies adopted by the UAE with counties such as the UK and Malaysia, while the final section consists of a summary of the chapter as a whole.

This chapter is intended to provide an understanding of international concepts relating to social housing, and to create an understanding of why social housing is important and must be considered by both developing and developed economies. Such policies are implemented to provide basic housing facilities to low-income groups and secure their life savings, and are heavily dependent on public-private partnerships.

4.2 Affordable housing

Affordable housing refers to housing units that members of society whose income is below the median household income are able to purchase. In general, affordable housing addresses the housing requirements of lower- or middle-income households, and has become particularly

popular in developing countries, where the majority of people are unable to purchase houses at market prices. People's disposable income determines their ability to afford a house, and a lack of the same can lead the government to seek to deal with the increasing demand for affordable housing (Bennett, Coleman & Co. Ltd., 2019). Affordable housing is especially important for families because it fulfils the basic human requirement for shelter and provides ensures wellbeing. Decent and affordable housing reduces stress and improves both physical and mental health, while it also supports the local workforce because people are better able to live in close proximity to their workplace. Due to the increasing population of the Gulf region and the lack of affordable housing, GCC countries are taking measures to improve housing conditions. The housing programme introduced by Sheikh Zayed provides housing facilities for eligible low-income families in the UAE, grants interest-free loans for those who wish to purchase, build, expand, or maintain a house, and provides government housing grants (Al Munajjed, 2013). The total cost of housing and infrastructure projects that have been completed by 2020 has exceeded to Dh 30.7 billion. The country has announced that an additional Dh 32 billion will be made available for Emiratis to build 34,000 houses by 2025 (Nagraj, 2019). In order to make this benefit accessible to the largest number of people, the income limit for a housing loan has been shifted to Dh 15,000 per month (Nagraj, 2019).

In addition, charitable associations throughout the GCC region have implemented various housing programmes to help low-income nationals in the region. The charitable foundation Easa Al Gurg, located in Dubai, builds residential projects for orphans and elderly people in the emirate. Another charity operated in the name of Sheikh Khalifa Bin Zayed Al Nahyan supports the restoration of houses in various emirates (Al Munajjed, 2013).

Various international organisations consider affordable housing to be a basic human right. The United Nations Housing Rights Programme (UN-HABITAT) states that governments should take appropriate measures to promote, protect, and ensure progressive realisation of people's right to affordable housing (Al Munajjed, 2013), and it is against this background that this study reviews affordable housing in selected countries.

4.3Affordable housing in the UK

4.3.1 Affordable housing

The UK government has adopted and implemented the concept of affordable housing, whereby certain eligible households whose housing needs are not fulfilled by the market can receive affordable housing in the form of affordable rent rates, social renting schemes, and intermediate housing. These affordable homes can take the form of newly purchased or newly built private properties. The UK government publishes annual statistics on the supply of affordable housing, including new buildings and acquisitions within the private sector, but not the sale or demolition of affordable homes. In its 2010 spending review, the government announced a National Affordable Homes Programme (UK Gov, 2014).

Affordable housing encompasses affordable rent, social rent, intermediate rent, and affordable home ownership (DCLG, 2013). In line with the UK's National Planning Policy 2012, affordable homes are understood to be housing units that are provided to a certain group of people whose housing needs are not met by the market. Eligibility is determined on the basis of allocation by the local authority, income standards, and local house prices. The concept of affordable housing must include provisions to ensure that affordable prices can be set at a standard that considers future demands.

The option of affordable rented houses was introduced in the UK in 2011. Affordable rented housing is one of the most important types of such subsidised housing. Both local authorities and private registered providers of social housing have the power to let affordable rented homes to eligible households in this regard, while the rate of affordable rent depends on rent controls (DCLG, 2013). Rent controls are a policy favoured by governments to help families on low incomes. For example, a government can impose a restriction to ensure that the rate of affordable rent should be at least 40% less than various options available commercially. It can also impose restrictions on the rates at which rent can be increased by landlords.

4.3.2 UK housing policy

In 1980, the government of then-Prime Minister Margaret Thatcher's introduced a 'Right to Buy' policy, which was the most significant innovation in UK housing policy in the last century. However, the policy was controversial from the time of its inception and encouraged polarised views across the political divide (Beckett, 2015). With this strategy, responsibility for housing was firmly devolved to England, Wales, Scotland, and Northern Ireland. The stance of each governments towards housing was different, which further divided the country (Ryan, 2018).

The UK government's housing policy assists local councils to plan and build advanced accommodation for entire communities. This policy seeks to build affordable housing, help more people to buy their own homes or live in decent rented accommodation, improve the quality and conditions of rented houses, and provide enhanced support to vulnerable people for their housing needs (Cabinet Office, 2014).

The UK's housing policy advocates ownership, rather than fulfilling people's housing needs in the context of rented facility. Successive governments have sought to ensure that owning a home is always an ambition for people in the UK (Paris, 2010). In 2005, when owner-occupancy was at its peak, the country was filled with residential properties owned by private owners and as a result, privately owned properties accounted for 70% of the total (LSE, 2015).

For many people in the 21st-century UK, the dream of owning a home has become almost impossible. The country's population is growing, and houses are becoming physically smaller. This trend has been accompanied by a reduction in new construction rates of residential houses and buildings, illustrating the UK's current housing policy and the impact of previous housing policies. The private rental market is emerging as a significant sector due to the shortage of social housing provided by the government and the reduced number of new homes. Some of these private players have sought to exploit the poor and remove their right to shelter (LSE, 2015).

Developed countries have established and implemented their own tailor-made assessment systems for building accommodation, a pattern that is now reached several developing countries. The UK has worked on the Building Research Establishment Environmental Assessment Method

(BREEAM), which integrates various tools that are suitable for building designs such as industrial, eco, multi-residential, healthcare, education, retail, and office, and prison buildings. However, it is also important to evaluate the environmental performance of these buildings. This should include evaluations of buildings' surroundings and their performance in the wider neighbourhood. The quality of the environment and the performance of the area can be improved by the implementation of a common building district. It is to this end that the Comprehensive Assessment System for Sustainable Housing (CASSH) has been designed to address significant needs and assess the wider scope for development pertaining to the housing sector (Bakar, Cheen, & Rahmawaty, 2011).

4.3.3 UK future housing needs

Future needs and demand are integral to future policy and decision making. The Institute for Public Policy Research in the UK submitted a report in March 2011 stating that if the rate of construction continues according to previous trends, while patterns of immigration and household formation remain constant, along with the projected increase in the population, the demand for housing will clearly outrun supply by 750,000 by 2025. However, in 2012, the Future Homes Commission argued that at least 300,000 houses need to be built every year if supply is to keep pace with demand (Heath, 2014). If current policies and past trends continue, it is highly likely that more people will become homeless, and this being so, it is necessary for the government to consider strict planning decisions regarding services, land requirements, and local government finance for future housing investment (Heath, 2014).

The gap between the actual number of new houses and the estimated annual demand for housing is wide and increasing. The total housing shortfall across England from 2012 to 2013 was 396,610 (Heath, 2014). Housing prices in the UK have risen so high that many people struggle to save enough for a mortgage deposit, and the high demand further increases prices. In particular, England has facing an extreme shortfall of housing and requires at least 240,000 homes to be built every year to keep pace with the demand. Current numbers amount to less than half of what is required, however, which is exacerbated by the fact that many housing projects are started and not completed, thereby adding to the waste of the nation's resources (Heath, 2014).

4.4 Affordable housing in Malaysia

4.4.1 Patterns of urbanisation

Malaysia, a developing country has experienced rapid growth in urban development. Alongside the growth and development of the economy, cities such as Kuala Lumpur and Penang have seen rapid population growth, as have other parts of the country. The large-scale migration from rural to urban areas of people who wish to secure better employment opportunities and improved lifestyles has triggered a housing problem, and increased the number of slum dwellers in Peninsular Malaysia, particularly Kuala Lumpur. However, it is not the case that all such migrants are responsible for the growth of slums, or that all migrants end up living in slums; there are factors that contribute towards the country's housing problems such as old and dilapidated houses and insufficient access to basic amenities (Wahab, 2003).

Malaysia's housing situation is strongly connected to the country's policies regarding housing programmes. It is necessary to understand and analyse low-, middle-, and high-income people to assess their needs, and to this end, the government is assessing various polices such as whether to concentrate on low-income groups to build high-density, low-cost housing, or high- or low-rise houses designed for middle- or higher-income groups.

The housing policies in place in Malaysia were drafted in consideration of the lower-income members of society, with the main objective being that this group should be provided with maximal opportunities to enjoy amenities and other services associated with housing. The main agencies responsible for housing development in Malaysia include (Soffian, Ahmad, & Rahman, 2018):

1. Public agencies: these include government authorities such as the Urban Development Authority, the Regional Authority, and government employee housing agencies. The Federal Land Consolidation and Rehabilitation Authority and the Federal Land Development Authority are regional authorities. The main aim of public agencies is to provide lower-income groups with housing at low cost. These agencies are involved in allocating housing sites and providing access to basic services and amenities in rural areas.
2. Private agencies: these include private real estate developers. They concentrate on fulfilling the demands of households in the medium- and higher-income groups. They are involved in the construction of houses at medium and high cost, while recently, private players have

begun to work with government authorities to provide low-cost housing for low-income groups.

4.4.2 Sustainable development

Many urban policies enacted to aid development or redevelopment focus on aspects of sustainable development, and urban policies are integral to the housing sector. Given that adequate housing is a prerequisite for human flourishing, Malaysia has developed a range of housing schemes. Current housing developments in the country are carried out in accordance with the principle underpinned under Agenda 21, and enshrined in the goals of the Habitat Agenda, which is the blueprint for sustainable development in the current century, having been adopted by Malaysia and 178 other nations. Housing is a fundamental part of urban development, and necessary to ensure the success of sustainable development.

For the people of Malaysia, the concept of sustainable development in the field of housing is new and unfamiliar. Houses built in the past fail to meet the current required criterion of sustainability because building designs were not developed in consideration of the concepts of green affordable housing and energy efficiency. To build green houses, specialised designs are required that are able to specify the purpose of installations and abide by the requirements of the green concept. To build green houses, it is necessary to employ relevant experts and professionals. Sustainable housing makes it essential to consider a range of social, economic, and environmental issues, and solve them in the correct manner.

4.4.3 Assessment of housing policies and strategies

The federal government of Malaysia has imposed various policies and strategies to provide a reasonable accommodation to lower-income groups and to this end, the government provides low-interest-rate funds and secures the services of various housing trusts. It is mandatory for the state government to provide land loans on nominal terms and maintain facilities such as roads, free-of-charge water mains, and roadside drains. These policies were formulated based on a consideration of the technical and financial resources available in the country and the fact that state government jurisdiction is applicable for accommodation and housing, as per the provisions of the country's

constitution. Certain conditions were imposed when these policies were initiated by the Ministry of Housing and Local Government in 1961, which run as follows (Wahab, 2003):

- The housing trust is responsible for preparing the layout, plan, and design of low-cost housing, and should undertake all site and auxiliary work when supervising a project.
- The loan amount provided by the government must only be spent on the development of housing sites or other auxiliary services.

Under current schemes, various mechanisms are provided with respect to the repayment of loans and housing facilities in order to ensure that low-income groups can easily make use of loans and move into better housing facilities.

4.5 Affordable housing in the US

There have been various housing crises that have led the US government to pursue housing programmes to benefit low- and moderate-income groups. These crises include the Great Depression, the urban crisis, and the post-war housing crisis (Hoffman, 2012). Public housing programmes were first rolled out by the administration of then-US President Franklin D. Roosevelt during the Great Depression. There was also an acute shortage of housing after the Second World War. To eliminate the urban housing crisis in the late 1960s, specific goals were set by the Johnson administration to construct national housing. As a result, two large low-income housing production programmes were implemented in order to subsidise private industry. In 1970, the administration of then-President Richard Nixon implemented further policies and devised a system of vouchers (Hoffman, 2012).

Leins (2020) has found that there is not a single county in the entire USA where a minimum-wage worker can afford a rented two-bedroom apartment. Cities such as New York and San Francisco are known for their high cost of living, while the lack of affordable housing has become an issue that affects the whole country. Since 2016, around 44 million Americans have been negatively affected by the cost of housing; a survey conducted in 2018 revealed that more than one-third of Americans who rent a home were unable to afford to purchase one. There is also a tremendous discrepancy in the affordability of housing between various cities in the USA (Rudden, 2019). The largest hindrances to home ownership for young people are student debt, the high cost of a down

payment, and the lack of affordable housing for low-income renters. One survey found that the biggest obstacle to improving the affordability of low-income housing is the lack of federal and state funding for such programmes, while residents of colour also face a dearth of bank financing for housing purposes (Rudden, 2019). The affordability of housing facilities is the most significant concern in USA, and it is essential that the government and private organisations work together to resolve these challenges by supporting people with loans and offering them affordable housing facilities.

4.5.1 Contemporary conditions

In 1930, a large proportion of the US was underdeveloped, with limited telephone facilities and a lack of electricity supplies. The quality of housing was much worse than today, with many buildings being old and obsolete, lacking toilet facilities; even in the large city of St. Louis, people were forced to use outhouse facilities with cold water. In 1930s, the home ownership rate was fairly low, and fewer than half of Americans had their own homes, but from the start of the 20th century, there was a rapid reduction in the amount of overcrowding in slums (Hoffman, 2012).

The effects of the post-war housing crisis were long-lasting. The aftermath of World War II in the US resulted in the demobilisation of the armed forces, with a decrease in active duty personnel from 12 million in 1945 to 3 million in 1946. This sudden event led to a severe housing shortage. In the years following 1945, the number of new houses increased to more than a million annually, and in 1950, the number reached 2 million, while the housing boom continued into the 1960s, driving the growth of the economy (Hoffman, 2012).

In 2002, the bipartisan Millennial Housing Commission developed a new housing policy, publishing a report suggesting ways of meeting the housing challenge. It was the second most comprehensive congressional report on housing policy since 1990, and in 2002, national ownership increased to 68.1%, compared to 64.1% in 1990 (Weiss, 2002). US governments have promoted housing policies as a result of having learnt hard lessons from history, one of which is that housing programmes should be decentralised. A renting policy could be advantageous for the US because it would to reduce maintenance and ownership burdens (Hoffman, 2012).

4.6 Affordable housing in GCC countries

The GCC consists of six countries: Saudi Arabia, the UAE, Kuwait, Oman, Bahrain, and Qatar. Housing expenses tend to be considerable; the upkeep and construction of houses requires years of the average citizen's income, and these costs increase over time. These challenges are particularly acute in Abu Dhabi and Dubai, where transformative urbanisation has led to a flow of the workforce from rural to urban areas. There are three distinctive submarkets in the country: expats with low incomes, expats with high incomes, and citizens. There are several factors that are responsible for increasing housing prices, but these factors vary between the various emirates (Smith & Freeman, 2014). Some of these factors are as follows:

- **Islamic financing and land use or land occupancy rates**

Islamic and Sharia principles have lately been applied in the housing market in the Gulf region. Sharia-compliant forms of financing such as *Musharka*, *Ijara*, and *Murbaha* make it difficult for the Gulf region to confront the challenge of affordable housing, while land use patterns such as *Waqf* have evolved in different locations in the GCC (Smith & Freeman, 2014).

- **Rapid urbanisation and technology**

Many countries have experienced rapid urbanisation in recent decades, which has brought many people to suburbs and other urban areas. This had led to the use of inferior technology, low-skilled labour, and low-cost materials to satisfy the large demand for new houses, giving rise to a proliferation of informal settlements and shanty towns. In the arid climate of the Gulf region, peri-urban expansion is not sustainable, given the shortage of cooling and drinking water facilities (Smith & Freeman, 2014).

- **Recent urbanisation**

Much of the Gulf area has grown rapidly in the last few decades, and this fast-growing market has generated creating due to the high inflation rate (Smith & Freeman, 2014).

- **High footfall of expat residents and workers**

There are two types of expat in the GCC: those at the managerial level, and those working as labourers. Expats account for 80% of the workforce of Saudi Arabia, 67% of the Kuwaiti population, and 90% of the workforce of Dubai (Smith & Freeman, 2014).

- **Multi-tiered residential markets segregated by location, law, and configuration**

Housing in the Gulf region is segregated into that for citizens, affluent expats, and labourers. Layout, location, and configuration are different for these three markets (Smith & Freeman, 2014). Housing in Qatar is cheaper than in the other GCC countries. The average residual income in Qatar is USD 7,499, which is the second highest in the GCC after the UAE, which has an average household income of USD 10,529. The highest proportion of income in Qatar is spent on housing (Smith & Freeman, 2014). The average cost of housing being USD 3,030. Table 4.1 shows the average household income and housing costs in GCC countries (Smith & Freeman, 2014).

Table 4.1: Average household income and cost of housing in Gulf countries during the period 2005–2007

	Average Monthly Household Income		Average Monthly Housing Costs	
	National currency	PPP International Dollar	National currency	PPP International Dollar
Bahrain	1,214	3,793	312	975
Qatar	41,483	10,529	11,937	3,030
KSA	9,183	3,200	2,141	746
UAE	42,360	15,689	7,064	2,616

Source: (Smith & Freeman, 2014)

The countries with the least affordability are Saudi Arabia and Yemen, while the lowest residual income is found in Yemen, at USD 1,758 per month. Bahrain is a median country. Figure 4.1 shows the affordability indicator of the five Gulf countries.

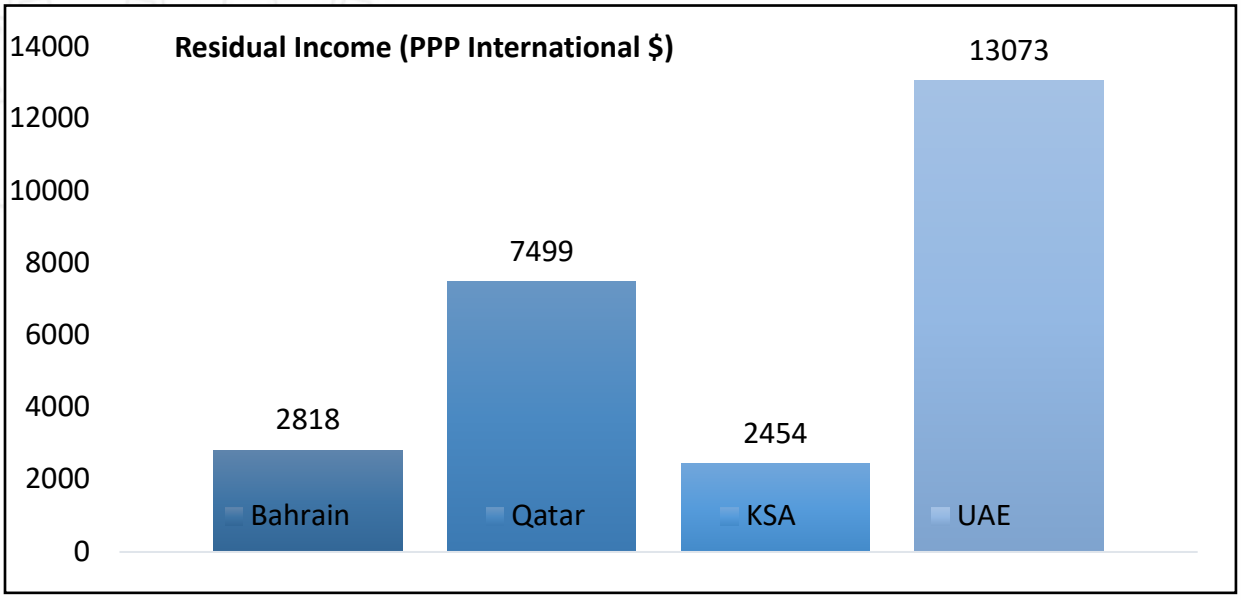

Figure 4.1: Affordability indicators in five Gulf countries, 2005–2007
Source: (Smith & Freeman, 2014)

The housing cost-to-income ratios of these countries are presented in Figure 4.2.

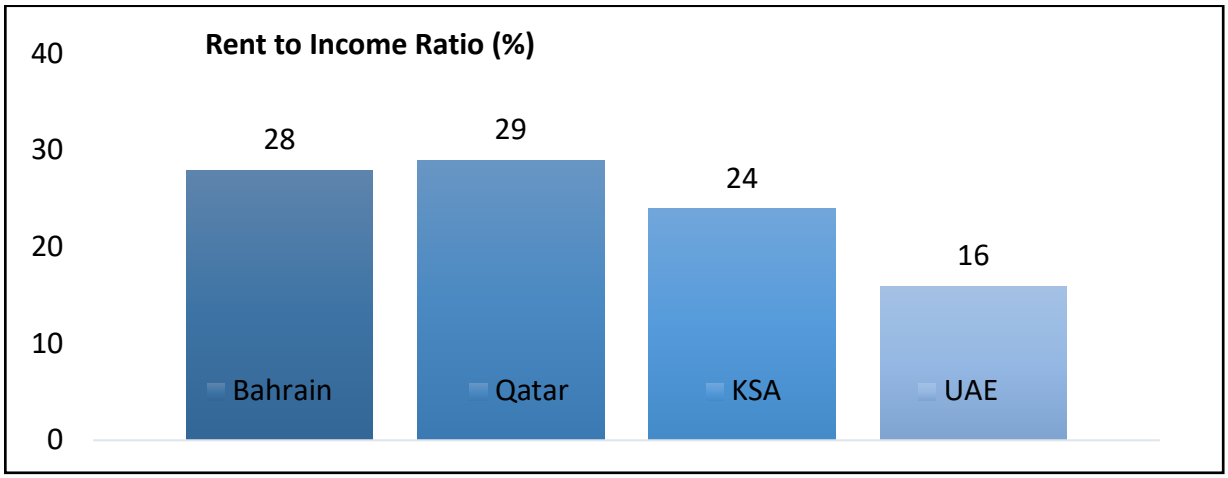

Figure 4.2: Housing cost-to-income ratio
Source: (Smith & Freeman, 2014)

Cost and affordability are the key determining factors in the cost of production in the economy. The affordability of housing in the Gulf States has increased significantly over time, and it has become necessary to induce private players such as banks and developers to either construct homes or provide loans (Smith & Freeman, 2014).

4.7 Best value in housing programmes

4.7.1 Best value procurement in the UK social housing sector

With changing market conditions worldwide, coming at the same time as advancements in technology and increasing client expectations, the practices and processes of construction have been placed under scrutiny. The practices of construction have been revaluated in the UK's construction industry, with a particular focus on public sector projects. The provision of social housing in the UK is covered under two main authorities: local authorities, and housing associations and other related organisations.

Both the private and public sectors have embraced best-value procurement while partnering with the social housing sector; however, these policies are also affected by various political considerations, which led to the redrafting of legislation designed to meet the needs of individual registered social housing landlords in the UK. New legislation enacted in 2000 by the UK government introduced the best-value regime, which applies to all services used by the public and controlled by local authorities. As per this legislation, local councils are required to review, examine, develop, and show aspects of continuous improvement with regard to procurement strategies to ensure their efficiency, economy, and effectiveness.

The UK government defines 'best value' as the optimal combination of quality that is required to meet user expectations. An indicator of long-term value regarding the full life of the asset is valued over low cost. The relationship between the long-term costs associated with a project and the benefits gained by the owner is considered to represent best value for money.

With respect to building contracts and designs, a detailed paper by Phillips, Price, & Dainty (2004) found that the factors presented below can make it harder to procure best value in social housing construction projects:

- There is insufficient time to evaluate a standard tender;
- The system for value with respect to clients must be made explicit;
- Contractors often construe the entire system of best-value tender interviews to be a game of marketing skills and appearance; and
- Costs should be considered on a whole-life basis, rather than in terms of capital cost.

However, the concept of best value has been challenged in the UK courts because there is an intrinsic conflict between the contractual obligations as per the standard form of construction contracts and the underlying ethos of collaborative working (Phillips, Price, & Dainty, 2004).

4.7.2 Best value social housing in Malaysia

The Khazanah Research Institute (KRI) has found that in 2014, the average house price in Malaysia was 4.4 times the average annual household income. Even though house prices in Malaysia are not as high as in Hong Kong or in Singapore, to be affordable, a market needs to offer multiple types of median housing prices, such as those that cost three times the median annual household income. There are various common challenges associated with housing affordability in Malaysia, such as the fact that housing costs are increasing disproportionately quickly, compared to household incomes. At the same time, the affordable housing supply is not meeting demand; there is a scarcity of land that is appropriate for affordable housing; demographic changes are taking place with regard to household size, population growth, and an ageing population (World Economic Forum, 2019).

4.7.3 Best value social housing in the US

Affordable housing is a fundamental part of the health and welfare of citizens, as well as the smooth functioning of the local economy, and both of these factors are embedded in the Universal Declaration of Human Rights issued by the United Nations. It has been estimated that 330 million urban households across the world live in substandard housing, or are financially stretched by the cost of housing. Some 200 million households in the developing world live in slums, while around 60 million households in the US are financially stretched by housing costs. Replacing substandard housing and building the additional units that are required by 2025 would require an investment of $9 to $11 trillion for construction purposes. The affordability gap in housing is equivalent to $650 billion every year, or 1% of the global GDP, but in the least affordable cities, the gap exceeds 10% of the local GDP (McKinsey Global Institute, 2014).

4.7.4 Best value social housing in the GCC

Most affordable housing projects are based on three procurement models: traditional or fully public procurement; semi-private or public-private partnership (PPP) models; and fully private or privatisation approaches. Under the first of these, the government accepts total responsibility for the design, construction, and financing of infrastructure, and is fully responsible for core as well as non-core services during the operational phase of construction. Under the PPP procurement model, the government involves the private sector for the purpose of designing and constructing facilities, but responsibility for the providing services is equally distributed between the private sector, which provides non-core services, and the government, which provides core services during the operational phase. Under the PPP model, the government contracts the private sector to design and construct facilities, and assigns it responsibility to provide both core and non-core services during the operational phase (KS Law, 2017). For affordable housing projects, the PPP model is different, in that less emphasis is placed on core and non-core services and more attention is paid to the support given to the private sector in order to ensure the financial viability of the project (KS Law, 2017).

4.8 Comparison between the UAE and certain selected countries

4.8.1 Comparison between housing strategies in the UAE and UK

The public policy for housing strategies that is in place in the UAE aims to enhance the number of beneficiaries who are covered under various public housing programmes. It is also intended to enhance cooperation between the various housing programmes initiated at the local and federal levels, and emphasising improving coordination while grading, classifying the potential of housing programmes, and improving safety mechanisms in the country. The housing strategies of the UAE government are intended to increase cooperation with the private sector to achieve these aims. The government has undertaken various initiatives including the formation of new housing strategies, coordinating the implementation of such strategies with local housing programmes, and establishing a standardised committee for road specifications at both the federal and local levels (UAE Gov, 2015).

In the case of the UK, there is need for an active, thriving, but stable housing market that is capable of offering affordable housing, flexibility, and choice to promote social and economic wellbeing.

The UK government has worked hard to develop the housing market and establish certain trends that take account of future needs, given that for many UK citizens, it is no longer possible to purchase a home, while landowners are exploiting middle- and low-income groups. However, the government has so far failed to reduce the gap between the demand and supply of houses, and the rate at which homes are being built still does not meet demand, revealing the need for urgent action by the government. The housing strategy of the UK revolves around building more homes so as to solve associated social and economic problems (HM Government, 2011).

4.8.2 Comparison between the housing strategies of the UAE and Malaysia

The housing strategy pursued in the UAE supports low-income groups in by providing affordable housing. The infrastructure and real estate sector of the UAE has contributed significantly to the country's economic development, of which housing is an important component. Both governments and private players are fully supportive of the country's efforts to fulfil the demand for housing among people of various income groups. Sustainable development is not a particularly significant problem because houses are integrated with advanced technologies and built based on environmental considerations.

Malaysia is a developing country that is struggling with a housing problem due to migration and other factors. The cost of housing is such that low-income groups in Malaysia are unable to afford their own homes, but the government of Malaysia has not developed a strong strategy to combat this issue. Another problem is that of sustainable development; houses tend not to be built with the latest sustainable technologies in place.

The government of Malaysia would do well to formulate better housing strategies and implement them with the help of private players, as well as ensure that all current and future residential properties are constructed in light of the latest advancements in the field of sustainable development.

4.8.3 Comparison between the housing strategies of the UAE and the US

Because housing is a major financial sector in the US, the country's tax code is a significant policy instrument. Public policy influences the sector in various ways, such as by supporting programmes that provide loans. There are also targeted low-interest credit initiatives such as the Federal Housing Administration, the Veterans Benefits Administration, and permissions granted to certain people to borrow below interest rates in the market. Agencies such as the Federal National Mortgage Association facilitate the smooth functioning of secondary mortgage markets, while federal and state-local programmes are in place to help low-income households purchase homes through community development grants, the direct intervention of the public sector in building public housing, and subsidies for the construction of low-income housing. The US government emphasises the implementation of VM for construction purposes to ease processes and manage operations more efficiently (Sharpe et al., 2018).

4.8.4 Comparison between the housing strategies of the UAE and the GCC

VE has developed rapidly in Saudi Arabia, and it has played a significant role in government projects and the private sector. However, VE has not been successfully implemented in Kuwait, perhaps due to a lack of vision, a failure to recognise the strategic benefits of this approach, or a lack of incentives or policy demands. The social housing policies followed in Kuwait, Saudi Arabia, and Jordan emphasise the needs of low-income citizens who are unable to purchase or construct a home. These governments offer various grants and loans to help low-income citizens to develop their residences. Overall, the public policies in place across the GCC are similar to those in place in the UAE, in that they all are designed to help the needy to build or purchase a home (Alazemi, 2011).

Comparison of the achievement of value

A comparison of the strategies of the UAE and those of the GCC, the UK, the US, and Malaysia reveals that the UAE perform better than some countries, as shown in Table 4.2. The UAE is ahead of Malaysia and the UK in terms of housing policies, but it lags behind other GCC countries and the US. VM is more in evidence in the US the GCC countries are much farther developed than the

UAE in terms of VM and VE. Affordable housing is well developed in Qatar, while the US authorities have implemented a range of strategies to provide affordable housing, placing considerable emphasis on rental policy. VM standards for projects are more common in the US, compared to GCC countries and the UAE because in the US, projects are value-orientated and cost less overall.

Table 4.2: Housing policies of five countries, and implementation of VM

Aspect	Country / region				
	UAE	US	UK	GCC	Malaysia
Housing policies	Average	Strong	Weak	Strong	Weak
Implementation of VM	Weak	Strong	Strong	Average	Strong

4.9 Summary of Chapter 4

This chapter has evaluated the housing needs, concepts, scope, and significance of various developed and developing countries. It is clear that housing forms an important part of each country's development policy because it strongly affects the society and economy. When lower-income people are provided with better housing facilities, the country's social conditions can be said to have improved. However, as countries develop, the demand for affordable housing is significantly outstrips the supply, revealing an urgent need to redraft national legislation and housing strategies in all the countries examined in this chapter to better meet housing needs. In addition, governments should ensure that such houses are built sustainably.

Housing strategies must ensure that new residential developments must follow environmental standards and be located in the vicinity of an adequate infrastructure. The UK, Malaysia, the US, and the various members of the GCC are all examples of countries in which the majority of people in low-income groups have moved from slums to reasonable housing communities, ensuring them a better standard of living.

Chapter 5 – A CONCEPTUAL FRAMEWORK FOR THE RESEARCH STUDY

5.1 Introduction to Chapter 5

This chapter partially reviews a number of conceptual frameworks and explores their suitability with research. The alternative frameworks are first defined, followed by a discussion of their uses, identification of their type and steps involved in their implementation. Finally, a suitable type is selected and; a conceptual framework is developed for this research to addresses the various factors that affect housing in the UAE.

5.2 Meaning of conceptual framework

A conceptual framework is an analytical tool (Richard, 2015) used to organise ideas, make conceptual distinctions, and provide a structural framework for research. A framework indicates the direction, scope and focus of an endeavour. VE and VM are structured and analytical processes that influence value for money by taking account of all necessary functions to consistently ensure the lowest costs and highest-quality standards (Richard, 2015). VE/VM will thus feature in the framework of this study.

5.3 Uses of conceptual frameworks

A framework that is based on concepts is termed a conceptual framework. Such a framework draws on concepts from various theories and findings to guide research (Rocco & Plakhotnik, 2009), keeping it on track and providing clear links between the literature and the research goals and questions (Rocco & Plakhotnik, 2009). Furthermore, a conceptual framework tracks the variables of a study (Rocco & Plakhotnik, 2009); for it to be completed in such a way that it clearly communicates with potential readers (Rocco & Plakhotnik, 2009). Crucially, a conceptual framework develops essential common terms and understandings for the researchers associated with the research in question, articulates a broad mission with clarity, builds collaboration among various parties, creates a unified perspective across disciplines, and expresses common beliefs and values about the topic being studied (Green, 2014). Researchers employ a conceptual framework to aid in preparing financial statements and accounting standards. It establishes a common

ideology for accounting practices and standards, while it also emphasises coming to an understanding of the study variables, rather than just predicting them.

Through a conceptual framework, it becomes possible to develop a coherent, balanced vision of purposeful learning, and contextually place the knowledge learned from best practices, history, and experiences. Researchers make use of conceptual frameworks to prioritise content and promote purposeful thinking, as well as demonstrate the hierarchical relationship between activities (Green, 2014). The use of a conceptual model increases the transparency and accountability of decision making.

5.4 Types of conceptual framework

Conceptual frameworks can be classified into five concrete categories, the selection and formation of one of these is dependent on the purpose of a study. The types of conceptual frameworks are outlined in Table 5.1 (Shields & Tajalli, 1998) and differentiated below.

Table 5.1: Types of conceptual framework
Source: (Shields & Tajalli, 1998)

Type of conceptual framework	Research purpose
Working hypothesis	Exploration
Categories	Description
Practical ideal type	Gauging
Formal hypothesis	Explanation/prediction
Models of operation research	Decision-making

- Working hypothesis: Researches that are exploratory in nature are linked to this conceptual framework. This framework is the preliminary stage of conceptualisation, and leads to the discovery of critical facts. Working hypotheses are never proven; they are simply supported with empirical evidence. This type of framework is typically used in qualitative research, while data are collected via field studies, structural interviews, and focus groups (Shields & Tajalli, 1998).
- Descriptive categories: This is the easiest and most basic framework. It is linked to studies that are concerned with the 'what' question, and is chosen as a framework when a researcher finds that basic information is missing from the literature review. In this type of

research, survey and content analysis techniques are used to handle data (Akadiri, Chinyio, & Olomolaiye, 2012).

- Practical ideal type: This conceptual framework corresponds to the research purpose of gauging. When a researcher is required to suggest recommendations to improve the functioning of any variable, this framework is suitable. Case studies, surveys, document analysis, content analysis, and structured interviews are used to collect data in this type of study. This framework is a form of combination of categories and working hypotheses, and is suitable for studies in which recommendations are made on the basis of the selected evidence (Shields & Tajalli, 1998).
- The formal hypothesis: This conceptual framework is used in explanatory research that addresses 'why' questions. This type of framework employs two variables: X and Y. If X is true, then the Y variable is affected. This gives rise to two formal hypotheses, one associated with the abstract theory and another that is interpreted or operational. The interpreted hypothesis includes two variables, i.e. one that is dependent and another that is independent (Shields & Tajalli, 1998).
- Models of operation research: When the purpose of research is to make final decisions on the basis of data collected, a conceptual model of operational research is used. It answers questions such as identifying the best decision and the most suitable approach. This framework is applied in studies that relate to quantitative techniques of operational researches. Here, cost-benefit analyses, linear programming, cost-effective analyses, and decision tree techniques are used for data collection or analysis (Ordoñez, 2014).

This research study made use of the working hypothesis conceptual framework because it involves formulating explanatory hypotheses that will be tested with the help of survey data.

5.5 Steps of a conceptual framework

A conceptual framework is composed of a number of concepts and the relational linkages between their variables. These concepts abstractly describe and name the objects, which provide a separate identity and meaning. In quantitative research studies, a conceptual framework is typically constructed after the literature review, while in qualitative research studies, this takes place after the results have been interpreted (Ekborg, Ideland, & Malmberg, 2009). In this study which is

mainly quantitative, the conceptual framework was developed after the literature review and in advance of empirical data collection.

Before preparing the conceptual framework, a number of steps need to be followed, as mentioned below. It is necessary to take account of various inputs before working on a conceptual framework. The two key elements are experimental knowledge and the literature review.

The key steps for the development of the conceptual framework are as follows (Chetty, 2015):

1. Identification of the key variables: The first step of the conceptual framework is to identify the key variables in the research study.
2. Literature review: Data are collected from published studies and journal articles on the theme in question to obtain reliable information.
3. Isolate the important variables: A review of the literature makes it possible to identify specific variables. These are typically found in abstracts, silent findings, or summaries.
4. Select one key variable and brainstorm all eventualities related to it.
5. After defining the variables, the researcher focuses on the relationships between the variables and identifies useful relationships.
6. Generate the conceptual framework: Develop the conceptual framework from the mix of the variables, and outline it clearly. The conceptual framework can be presented in the form of a flow diagram, tree diagram, shape-based diagram, or mind map.

This guide was followed in developing a conceptual framework in the course of this research.

5.6 Factors affecting the development of housing in the UAE

The key issues affecting the provision of housing in the UAE are shown in Figure 5.1. There are six key factors that affect the housing projects undertaken in the UAE: the availability of infrastructure, budget allotted, influence of government, culture, demand and supply, and location of projects.

The main objectives behind the use of VM and VE are resource conservation, cost efficiency, and ensuring design solutions are suitable for human adaptation. Some of the strategies that can be adopted to promote the conservation of resources are energy, material, and water and land conservation, while cost efficiency can be maintained by reducing initial costs, the costs of use, and recovery costs. It is also necessary to protect physical resources and human health to allow projects to conform to human adaptation (Akadiri, Chinyio, & Olomolaiye, 2012).

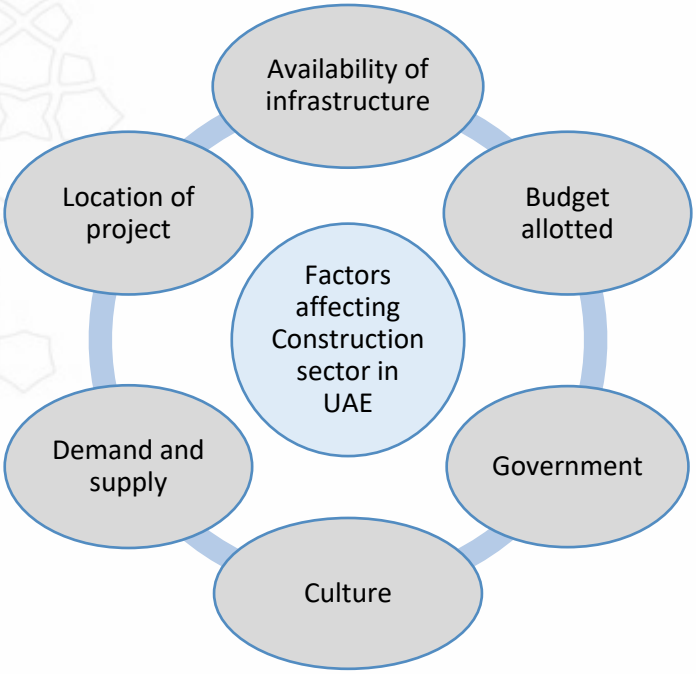

Figure 5.1: Factors affecting the construction of public-sector housing in the UAE

Various factors that affect housing in the UAE are outlined as follows:

- **Location of project**: This is a major factor that affects housing procurement plans because the social status of the surrounding area is extremely influential. The initial response of many customers is that a housing plan must be accessible to a broad range of local services and facilities that promote social wellbeing. The location of the project must fulfil all relevant criteria and meet customers' needs. It is this factor that will dictate the overall popularity of a housing project. A positive development has a long-term positive impact on the nature of the area and the community, and the desire to ensure a good location will motivate developers to control and measure different perspectives. The location also influences the cost of a plan because a location with high value attracts more advanced development, disincentivising the development of projects with low value on high-value sites. Generally, urban locations are more expensive than those in rural areas (Cunningham, 2013).

- **Availability of infrastructure**: The availability of infrastructure also affects the construction industry, which includes factors such as design, transportation costs, communication technology, and other aspects of the building environment. The industry is

dependent on the performance of available infrastructure such as rail, power stations, roads, and the telecommunication network in order to remain competitive. The productivity of the construction industry is dependent on the efficiency of infrastructure; a developed and advanced infrastructure will give the housing and construction industry a competitive advantage because it favours the widespread use of subcontractors and attracts a connected labour force. This ensures that unnecessary costs of travelling and transport do not occur. The construction industry seeks to maximise profit by reducing costs, and the factor of infrastructure availability is therefore extremely important because it significantly affects the profitability of the industry (Cunningham, 2013).

- **Supply and demand**: The supply and demand of housing affects the construction sector. A high demand will contribute to the success of the industry because all consumers wish to have access to shelter from the external environment that offers basic amenities and facilities. On the other hand, low demand will have a negative effect on construction companies. When there is high demand for housing, customers are more likely to have access to sustainable housing that features enhanced facilities. The construction industry has undergone many changes over the years due to the number of factors that affect the supply and demand of housing. These factors help to identify resource allocation and interest in the process of land utilisation. Increasing demand for housing may be prompted by enhanced expectancy rates, increased income, and a high level of affordability. Such increased demand fosters the growth of the construction industry, and economic development of the country as a whole.

- **Budget allotted**: The budget takes account of the income and expenses of proposed projects and programmes. The allocation of the budget defines the amount of money that is available to complete a desired plan. In the UAE, the government allocates financial and non-financial resources for state housing plans, while a specific management team prepares a plan for all relevant expenses that are required by the construction company to develop the programme. The allocation of the budget dictates the spending on raw materials, infrastructure, and other related aspects, and once it is established, construction companies can focus on cost-controlling methods that maximise profitability. The effective allocation

of the budget enhances the construction sector because it ensures ample resources. The allocation of budgets for housing plans differs from country to country, depending on a range of factors that can have a significant impact on the country's society. The industry tends to allocate budgets in such a way that it helps organisations to attain the desired goals and objectives in an effective manner. The budget allotted to the construction industry by the government determines working processes because most aspects of the industry are dependent on such budget allocations.

- **Government rules and regulations**: The rules and regulations implemented by the government also affect the construction sector. A policy of liberalisation can be followed if the government wants to promote the success of the construction industry. The UAE is a dynamic and growing country with a strong construction market that has accelerated the reform of various economic sectors. The government makes huge investments in housing programmes to develop the economy and strengthen the country's presence in the international market. Government regulations influence the prices of a range of products that related to housing programmes that foster the performance of the construction sector and maintain growth. Taxation and rental policies influence the construction industry in both a positive and negative manner. These policies can impact market supply and demand, which in turn affects the wider construction industry, revealing the important role of the government. Such rules and regulations affect the country's legal, social, political, and economic framework and serve to encourage or discourage construction and related services.

- **Cultural environment**: The construction sector needs to take account of the economic culture within organisations if housing programmes are to be efficiently developed. There are a range of different cultures that make up a society and the construction of buildings should suit these cultures. A culture consists of characteristics such as tradition, customs, norms, and religions. The management of cultural diversity is crucial for the success of housing projects because it greatly impacts on the supply and demand of housing programmes. The successful management of cultural differences will deliver a variety of advantages for projects and lead to organisational success. Cultural differences can

increase setbacks such as resource wastage and delays in construction projects. Cultural management significantly influences the growth of economic development. The culture of a society is made up of the people who reside in that society, and their changing tastes and preferences will influence the demand for products and services. Overall, the internal and external cultural environment can be said to impact on organisations' decision-making processes, which in turn affect the market (Richards, 2016).

The foregoing factors influence construction generally and housing provision in particular in the UAE.

5.7 Conceptual framework

A conceptual framework is the basis of any research; it represents a synthesis of the literature in such a way so as to explain the overall phenomenon being researched, and provides a map of the actions to be completed during the course of research, based on previous knowledge produced by other researchers. It also identifies the variables that will need to be investigated. The conceptual framework detailed in Figure 5.2 has been developed by means of hypotheses formulated (see below) based on the literature review. It depicts the relationship between the independent variables—VE in design and VE in the procurement process—and the dependent variables: the cost of production, competitive advantage, conflict avoidance, achievement of needs, and affordability of housing—via two variables.

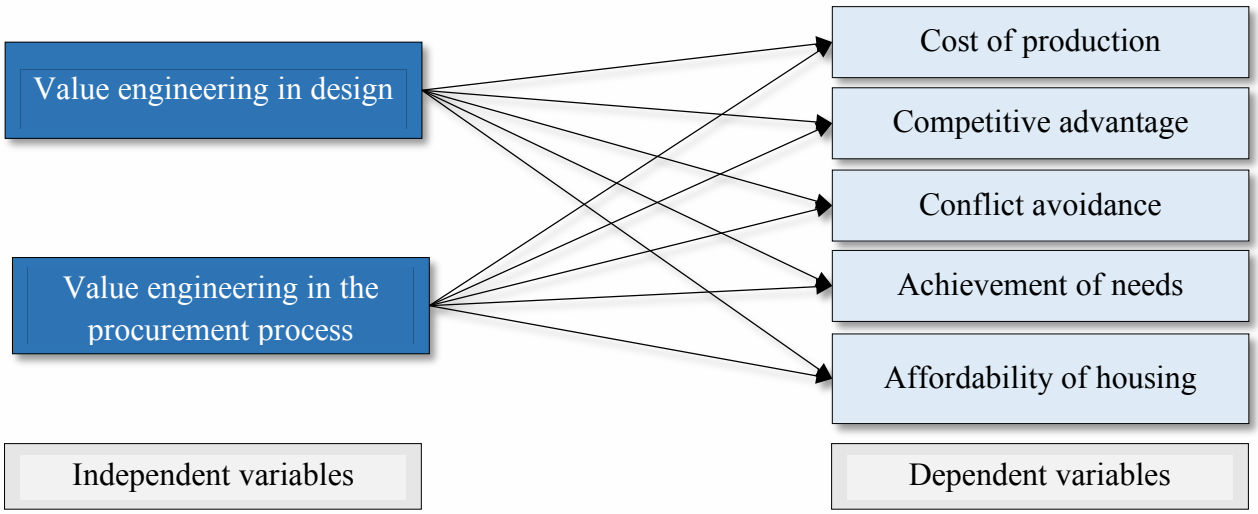

Figure 5.2: Conceptual framework for VE in the UAE housing market

5.7.1 Hypotheses

Ten hypotheses were formulated based on the literature review and the conceptual framework of Figure 5.2. These hypotheses are:

H1: Value Engineering in Design has a significant impact on the cost of production.

H2: Value Engineering in Design has a significant impact on competitive advantage.

H3: Value Engineering in Design has significant impact conflict avoidance.

H4: Value Engineering in Design has a significant impact achievement of needs.

H5: Value Engineering in Design has a significant impact affordability of housing

H6: Value Engineering in the Procurement process has a significant impact on the cost of production.

H7: Value Engineering in the Procurement process has a significant impact on competitive advantage.

H8: Value Engineering in the Procurement process has significant impact conflict avoidance.

H9: Value Engineering in the Procurement process has a significant impact achievement of needs.

H10: Value Engineering in the Procurement process has a significant impact affordability of housing

The dependent and independent variables of the research, which are reflected in these hypotheses and Figure 5.2 are explained below.

5.7.2 Dependent variables in the framework

The five dependent variables in the framework are outlined the following section.

5.7.2.1 Affordability of housing

VE can be applied during any stage of a project's development cycle, although the greatest benefits are typically achieved early in development, during the conceptual stages. The following are the typical applications of VE. It can be applied as a quick response study to address a problem, or as an integral part of an overall organisational effort to stimulate innovation and improve performance characteristics. In addition, VE can be used to enhance an organisation's quality programmes, product development activities, manufacturing processes, and architectural and engineering designs (Cunningham, 2013). The three chief resources in the construction industry are labour, plants, and materials, and it is the collaboration between the three that leads to the success or failure

of a given project. If that interplay is carried out in an efficient manner, then it will have a commensurate impact on the creation of value. Project teams can open opportunities to identify synergies between resources and problems. However, the extended categorisation of resources needs to be both realistic and manageable, if it is to be achieved in a manner that adds value to infrastructure projects. Waste is increasingly considered to be a 'value' aspect of infrastructure projects. It may seem slightly odd to consider the waste produced during the delivery of a project to be an item of value, but waste typically results from the use of materials, and cannot be regarded as being of value until those materials are not incorporated into the project; the greater the amount of a material that is not incorporated, the lower the resultant value the investment has created from that material. The use of VE in the management of waste as a resource can result in a changed appreciation of the potential value that this activity can create (Ochieng, Price, & Moore, 2017).

5.7.2.2 Conflict avoidance

One of the most important factors in VE is the attitude of the management and people on the task teams. A positive, supportive, and cooperative attitude is necessary and in many cases, VE requires a new management style; it cuts across organisational lines, considers taboo aspects of a problem, and recommends drastic changes, compared to the previous approaches. An attitude of faith and understanding is necessary to accept these disruptions to the old way of doing business, and to compete more successfully in the marketplace, VE can teach practitioners to improve their career skills, separate 'symptoms' from 'problems,' solve 'root cause' problems and capture opportunities, become more competitive by improving the 'benchmarking' process, and take command of a powerful problem-solving methodology that can be employed in any situation (Park, 1998). A construction project can create conflicts among stakeholders as a result of factors such as poor management and unclear goals and objectives, and VE helps to manage projects via proactive planning. This helps to reduce potential conflicts and maintain the quality and time management of projects (Park, 1998).

5.7.2.3 Competitive advantage

VE can be implemented in an organisation during the development phase of any product to optimise its value. A competitive advantage is the ability of an organisation to perform in such a way that competitors will not be able to match its level, or of a government to perform better than

its competitors. A firm or government can gain a competitive advantage by providing more valuable products to customers with the same level of investment. A VE approach makes systems more efficient and effective, and induces innovative techniques that can lead to a competitive advantage (Raheem, 2016). VE helps firms to meet customers' desires, which is one of the most important factors that can help organisations to differentiate themselves (Patil, 2010). Intensifying competition has placed growing importance and demand on increased efficiency, effectiveness, and value for money. VE is a proven management technique that can make valuable contributions to value enhancement and cost reductions in the process of building construction. It can help construction firms to achieve a competitive advantage in the areas of product quality, costs, and customer satisfaction (Rane & Attarde, 2016) and thereby develop quality and unique buildings for people. VE is a tool that can be used to optimise the balance between differing stakeholders' needs and expectations, and gain a competitive advantage over competitors.

5.7.2.4 Cost of production

Annappa & Panditrao (2012) looked at the case study of a universal testing machine (UTM) in which the design of the components and the material was changed following the application of the VE methodology. It was later observed that expensive materials and increases in the variety of hardware led to unnecessary increases in cost, and that when components were selected after applying UTM and VE techniques, significant cost reductions were achieved. VE motivated the development of alternative, less expensive materials, and a design modification for the dial bracket and top bearing bracket assembly (Annappa & Panditrao, 2012). VA has become an important tool in the manufacturing industry because it helps to reduce costs and produce better-quality products. This is driven by customer expectations and fierce commercial pressure; as products can remain competitive only if they maintain an optimal profit margin. The processes that make up VE help to drive down the cost of products, sustain profitability, and retain a market share, while reductions in cost are achieved by assessing processes, materials and products and offering alternatives. The rising cost of production is one of the most important issues currently faced by construction companies. Costs can rise as a result of a range of factors such as challenges in designs, errors, and the costs of materials, but VE can to reduce these costs, particularly by eliminating errors and improving designs at their different phases. In the construction industry, a chief focus is making

housing projects affordable. Housing must be affordable for people, especially those in the median or lower household income categories (Ahmed & Raheem, 2016).

VE is the systematic application of recognised techniques that identify the function of a product or service, establish a monetary value for the function, and provide the necessary function reliably at the lowest overall cost. In the construction industry, engineers seek to design projects in such a manner that they can be completed at the minimum cost, while ensuring the maximum output (Rangelova & Traykova, 2014). The benefits of a VM review are often perceived in terms of improved quality and reduced costs. VM exercises can also recover cost divergence (costs that diverge from the budget) that becomes apparent when design reports are prepared. In these circumstances, the client may have to choose a certain priority or decide to increase the budget. In this regard VM helps to identify items that can be omitted, those whose specifications have changed, those that can be re-designed later, if the budget allows, and those that can be incorporated into the design (Ilayaraja & Eqyaabal, 2015).

5.7.2.5 Achievement of needs

VE is a systematic, team-based, function-oriented approach that supports those who study the value of a product, service, or system. Its primary focus is cost reduction, alongside performance and customer-perceived quality; it must emphasise the value characteristics that are deemed to be the most important characteristics for customers. Many customers prefer customised products that can fulfil a variety of their needs, and VE critically analyses each aspect of design, modification, and standardisation (Ahmed & Raheem, 2016).

The process of VE starts with the identification of customer needs, and proceeds by means of an organised and systematic approach to create the optimum design that addresses these needs. Throughout this phase of design development, VE refines and enhances the concept, based on the latest research, and even after a product has been introduced and is in the production phase, VE enhances the product and responds to changing customers' needs (Sherwin, 1968).

VM is one of the most effective methods that can be employed to consolidate the needs and expectations of multiple stakeholders into a clear and agreed scope, and prioritise requirements on

an on-going basis. The application of VE is a creative process in which the greatest possible number of ideas is produced for consideration in order to cater to the needs of the customers. It broadens the range of potential solutions, and is essential to any innovative process (Thiry, 2014).

A construction project is not dependent on any single stakeholder, such as the customer; rather it must address the needs or concerns of different stakeholders such as the government, designers, customers, financiers, and other relevant professionals. VE helps to fulfil the needs of all stakeholders by clearly specifying the project's objectives, simplifying procedures, optimising the expenditure, solving root-cause problems, and reducing overall costs.

5.7.3 Independent variables in the framework

The two independent variables in the conceptual framework are explained below.

5.7.3.1 VE in design

In recent years, VE has significantly increased in importance in the construction industry. It works best as an integrated and collaborative process because in the traditional approach of design-bid-build, engineers, architects, project management personnel and procurement specialists have little impact on value creation, and are unable to affect it in a significant manner. Traditional construction methods lack full control over project outcomes and make it difficult to coordinate value-creating ideas, whereas VE enhances consolidation by aligning the processes of construction, design and other disciplines. VE should be used from the pre-design stage so as gain the maximum benefits. The design phase of construction is the most crucial because it is here that the foundation for the overall project is developed, and VE is a way of performing a deep analysis, at the same time as developing a more effective and efficient design solution (McGinnis, 2005).

5.7.3.2 VE in procurement

VE in procurement will rise to a range of challenges for managers. The procurement department can use VE to decide on alternative materials that can cost less, last longer, and are easier to install, as well as to buy and deliver materials at the correct time. Doing so will help to save time and costs, as well as to optimise the use of materials by helping procurement managers to each time select the right amount of the right material (McGinnis, 2005).

Procurement professionals can also use VE as a guide to select contractors and subcontractors for each work. In this way, managers have access to additional guidance on many aspects of a project that can optimise overall time, price, quality, financing, options for land acquisition, and project governance structure.

5.7.4 Review of the framework

The framework in this paper reveals the connections between the two independent variables (VE in design and VE in procurement) and five dependent variables (cost of production, conflict avoidance, competitive advantage, affordability of housing, and achievement of needs). These combine to give rise to ten different connections that may differ in terms of influence and importance. This study will now explore the potency of these connections by collecting and evaluating primary data, which will form the substance of Chapter 6.

5.8 Summary of Chapter 5

Housing construction in the UAE is a developed field that has access to advanced technologies and methods. However, the industry is affected by a range of factors such as the local government, culture, demand and supply, budget allocation, availability of infrastructure, and project locations. These factors significantly affect the sector in both a positive and a negative manner.

Chapter 5 has looked in detail at the dependent and independent variables of this study. The dependent variables are cost of production, competitive advantage, conflict avoidance, achievement of needs, and affordability of housing, while the independent variables are VE in design and VE in procurement. The overall purpose of Chapter 5 was to investigate the links between the dependent and independent variables. VE is a valuable method that can be employed in a project to solve problems, eliminate unwanted costs, and improve quality and function. The aim of VE is to increase product value and satisfy the performance requirements of products at the lowest possible cost. In the construction industry, the use of VE helps to consider factors such as the availability of materials, methods of construction, planning, organisation, and costs. In Chapter 5, this paper has shown how the use of VE in the design and procurement process can yield a number of benefits to construction firms. One particularly important factor highlighted earlier in

this thesis is that it is vital to start using VE methods at the inception of a project so as to leverage the greatest possible benefits.

Chapter 6 – RESEARCH METHODOLOGY

6.1 Introduction to Chapter 6

The project is related to the implementation of VE methodology in the construction of housing projects in the UAE. The construction industry of the UAE focuses on the strategic development of infrastructure, social development and education; and plays an important role in the economy of the country. The construction sector is also assisting in the development of many sectors in the UAE. In the last five years, a boom was reported in the infrastructure sector of the UAE. Construction projects in the GCC are valued at more than an immense $1 trillion. Two-thirds of this amount is undertaken in the construction industry of the UAE. The UAE has posted double-digit growth in the construction industry on a yearly basis and this has contributed to the GDP of the country being 15%. The unprecedented growth in the construction sector of the UAE along with the real estate sector has spurred growth in Abu Dhabi and Dubai as well. UAE is contributing 23% in the GCC economies (Kumar, Agarwal, & Khullar, 2010). The key drivers of the boom in the construction and real estate industries of the UAE include:

- Growing population of expatriates
- Friendly regulatory environment
- Ample liquidity

Nevertheless, UAE is a regional investment hub for international companies. The government is also introducing initiatives for recovering the confidence of investors and maintaining stability in the real estate sector (Kumar, Agarwal, & Khullar, 2010). Thus, the aim of the study is to reduce the cost of undertaking projects in the real estate and construction sector of the UAE. The study will be concentrating on the implementation of VE methodology for the purpose of reducing high costs incurred in public housing projects.

This chapter will describe the methods and techniques which will be used for accomplishing the objectives of this research. The research methodology section will give an account of the research philosophy, research approach and the research methods which will be used (Gialdino, 2009). The justifications will also be presented in this chapter for the choices made in the context of research

methods and approaches. This chapter will describe how and when the research approaches will be applied at different parts of research, how the data will be collected, what will be the samples for the research, how these samples will be selected and other such things. It will also include the details regarding the method of collection of data for the primary as well as secondary research and what data collection instruments will be used. The primary data will be analysed in the next chapter.

6.2 Literature review sources

Literature review is performed as a part of the secondary study. A literature review is performed to obtain the information related to the problem or issue in large amounts. Previous studies, government reports, books, scholarly articles, websites and other sources were referred to in the study for collecting the information pertaining to the topic. A literature review was carried out in this research and reported in Chapters 2-4. The other aspect of methodology concerns primary data and the subsequent aspects of this chapter will concentrate on it.

6.3 Research philosophy

Research is a method of analysing the complex issues associated with the study. It is a process to bring useful information related to the research study, irrespective of whether the report approach is qualitative or quantitative.

The components of research philosophy include:

- Epistemology: According to Blaikie (1993), epistemology is a theory or science of the methods of knowledge that are expanded into a set of assumptions about the ways where it is possible to gain knowledge about the reality, i.e. what can be known, how it can be known and what criteria must be defined in order to describe this as knowledge (Gialdino, 2009).
- Ontology: According to Bryman (2001), ontology deals with 'What is there?' It is a system that reflects the interpretation of an individual about a particular fact. It is necessary to conduct an ontological study as it details what entities or things exist about the particular fact or situation (Scotland, 2012).
- Axiology: Axiology is related to the values and logos which mean logic or theory. Axiology theory measures the intangible attitudes and values. In simple words, it measures

the level of development and the types of perceptual bias of a person in its thinking. Under axiology theory, the significant questions include the nature of value, criteria of value and status of value (Scotland, 2012).

On the basis of the review of the above three theories of philosophy, epistemology theory is applied in this research as this research is related to the understanding of the level of relationship between the application of VE and its influence on the cost of production, competitive advantage, conflict avoidance, achievement of needs, and affordability of housing. The epistemology philosophy has been utilised in this particular research by obtaining information and knowledge from multiple sources. The focus of this particular research approach is to explore the information that is true about VM in the construction industry. The epistemology philosophy has been applied by integrating the data obtained from the primary and secondary form of research. The logical knowledge was then obtained from analysis of the primary form of data. The conclusions offered in this research will be the form of empirical knowledge.

Epistemology theory deals with the sources of knowledge. In this research, different sources have been used to investigate the research objectives. Further, epistemology has been applied in this research by validating the findings and constructing the concepts with the help of secondary researches. Secondary researches helped in providing a foundation to the study along with providing logical reasoning.

6.3.1 Empirical study

The empirical study is a practical or pragmatic study. It can be of two types, namely experimental study or non-experimental study. In experimental research, a treatment is used to change the variables in one uncontrolled sample. In non-experimental research, subjects are observed without intervention (Rajasekar, Philominathan, & Chinnathambi, 2013). In this study, non-experimental research was adopted.

6.3.1.1 Deductive approach

A deductive approach is used to test the pre-established theories. The deductive approach flows from theory to hypothesis to observation and finally confirming previously stated statements. It is

also known as a top-down approach. These are quantitative in nature (Rajasekar, Philominathan, & Chinnathambi, 2013).

6.3.1.2 Inductive approach

Inductive approach also known as bottom-up approach is related to generation of new theory from emerging data. Contrary to the inductive approach, the deductive approach starts from an observation and leads to pattern, tentative hypothesis and lastly a new theory is generated. These are qualitative in nature (Rajasekar, Philominathan, & Chinnathambi, 2013).

6.3.1.3 Mixed-methods research

As the name suggests, mixed-method research is a methodology that involves the elements of both the inductive and deductive approach. In other words, mixed-method research involves the elements of both qualitative and quantitative research. It is also known as the integration approach that helps in understanding a problem effectively. Mixing both the approaches of research helps in offsetting the weaknesses associated with each of the research methods. In the mixed research method, there is a possibility of triangulation, i.e. several means are used for examining a single phenomenon. Successful triangulation requires a deep analysis of the information that is provided by each of the methods (Resource Centre, 2017).

6.3.1.4 Choice of approach

The study will use both inductive and deductive approaches, as the research will include qualitative as well as quantitative research. The inductive research approach is followed by collecting the data from different sources so that the research topic can be explored in depth. The sources in this can be both the primary and secondary sources. The inductive research approach helps the researcher in exploring the aspects associated with this research in more depth. In a deductive approach to research, the researcher develops the hypothesis or a theory along with designing a research strategy. The deductive research approach focuses on providing reasoning ranging from specific to general, and follows a path of logic and reasoning which is essential for many of the qualitative and quantitative studies.

Deductive and inductive reasonings are different approaches for conducting scientific research. With the help of deductive reasoning a theory is tested by the researcher by collecting and examining the empirical evidences. However, inductive reasoning will be used to gather and analyse the data along with constructing the theory. Deductive reasoning is considered as a standard that is used for the scientific research. Deductive research starts in general and then it becomes more specific in nature. Inductive reasoning on the other hand is exploratory and open-ended in nature. The inductive approach can be used for conforming hypotheses. Some of the best researches involve both inductive and deductive research (Saunders, Lewis, & Thornhill, 2009).

The research onion which is illustrated in Figure 6.1 is considered to be an important guide in determining the research methodology, as it allows the researcher to give a description of the stages of research which he/she needs to follow while formulating the research methodology. The main motive behind using the research onion is the fact that it illustrates and creates a series of steps using which the research methodology can be easily described and sequenced (Sekaran & Bougie, 2016).

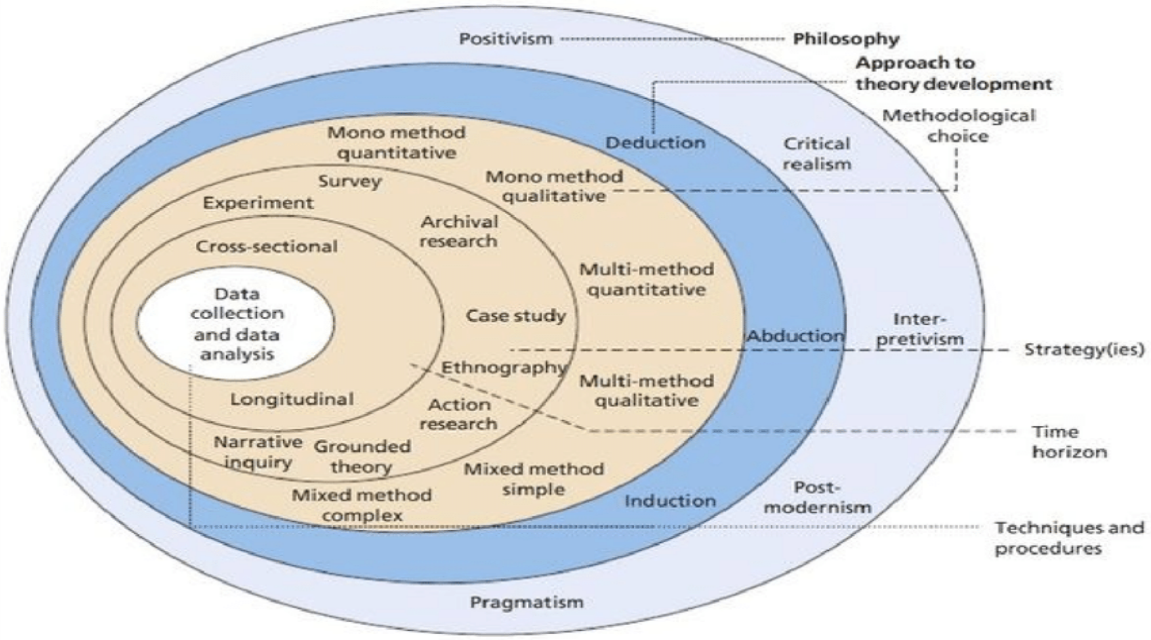

Figure 6.1: Research onion

Source: (Saunders, Lewis, & Thornhill, 2009)

The research onion for this study consists of the five major stages of research methodology (Saunders, Lewis, & Thornhill, 2009). They are:

Stage 1: Description of the philosophy of research

The adoption of the correct research philosophy is highly important for planning and carrying out the processes of research. Three major research philosophies which have been discussed in the research include epistemology, ontology and axiology. In this research, epistemology has been used as the chief research philosophy, as this research is aimed at identifying the level of relationship between VE and the five variables taken into consideration. This research philosophy deals with the sources of knowledge investigated for meeting the research objectives. Epistemology has been applied in this research to validate the research findings and use the secondary sources (Mkansi & Acheampong, 2012).

Stage 2: Description of the research approach

The research approach can be classified into two main categories, namely inductive and deductive approaches. This research has adopted both the inductive and deductive approaches. The deductive approach will be used to test the pre-established theories and will utilise the quantitative approach for evaluating the research hypotheses. The inductive approach will help in the generation of a new theory from the emerging data (Rosopa & Stone-Romero, 2008). The use of both the research approaches will help in eliminating the weaknesses associated with each of these research methods.

Stage 3: Description of the research strategy which has been adopted

For this research, both primary and secondary research methods were used. The primary research used the qualitative as well as the quantitative approach. Quantitative research was carried out using survey as the chief tactic, and the qualitative research was carried out using interview. The survey strategy can be linked to the deductive research approach (Sekaran & Bougie, 2016).

Stage 4: Description of the time horizon within which the research was completed

The fourth layer of the research onion highlights the time horizon of the research. There are two major time horizons in research. The first horizon is the cross-sectional method and second is the

longitudinal research method. In this research, a cross-sectional research is used to discuss the relationship between VE and procurement and the five dependent variables, and the research will be based on the results of the research at a particular point of time. Both qualitative and quantitative research methods will be used for implementing the cross-sectional research (Sekaran & Bougie, 2016).

Stage 5: Identification of the research methodology which is adopted for collection of data

This layer of the research onion provides a description of the particularities of data collection and data analysis. Quantitative data will be collected with the help of a survey questionnaire, where the survey respondents will be asked to answer some closed-ended questions based on a Likert scale. Qualitative data will be collected with the help of an interview instrument. The tools used for data collection are in synchronisation with the research philosophies and approaches mentioned above. The data analysis has been conducted with the help of correlation and regression analyses, as these are considered to be reliable methods for establishing relationships between variables (Saunders, Lewis, & Thornhill, 2009).

6.4 Research design

The research design is very crucial from the point of view of a project. Research design refers to the selection of overall strategy for coordinating the different elements of the study in a logical and coherent manner (Mypeer, 2015). Thus, research design ensures that the research problem mentioned in the study is addressed well. It entails a blueprint of the collection, measurement and analysis of data.

There are several types of research design that can be used in a study. Some of the research designs frequently used are descriptive, exploratory, experimental and cause and effect (Kothari, 2013). These various types of research design can be understood in the following manner:

6.4.1 Descriptive research design

The descriptive design is aimed at answering the questions of why, what, when, where and how pertaining to the particular research problem. The descriptive study is performed to know about the current status of the problem rather than ascertaining the answer of why. It describes what exists in the context of the respected variables or prevalent conditions (Parasuraman, Grewal, &

Krishnan, 2006). The descriptive research design is one of the effective scientific methods that are used in observing and describing the subject's behaviour in a completely natural setting without influencing it. This helps in obtaining real findings (Explorable, 2017).

6.4.2 Exploratory research

The exploratory study is preferred when there is less information available related to the topic for predicting the outcome. The concentration of the descriptive research is on gaining deep insight into the research problem. This type of research design assists in establishing the understanding of proceedings in the best manner for studying a particular issue (Kothari, 2013). Exploratory research design is used when the researcher has no past information or data or he/she has only few reference studies. This type of research is unstructured and informal. It also serves as a tool for conducting an initial research along with providing a theoretical idea for the research problem. This type of research is also conducted so as to determine the nature of a problem along with helping a researcher to understand the problem effectively. This often requires the researcher to use different sources for research (USC, 2017).

6.4.3 Experimental research design

Experimental studies enable the researcher to control the factors affecting the results of the study. Experimental researches are often used when time priority is evidenced in the causal relationship such that cause precedes effect (Bajpai, 2011). In an experiment, the researcher manipulates one or more variable/s, while randomising and controlling the rest of the variables of the study. It also has a control group and the subjects are randomly assigned. It is important to determine the variables along with testing and measuring the same (Kumar, 2014).

6.4.4 Cause and effect design

The cause and effect design is used when there is a conditional statement in the form of X then Y. A causal effect shows the relationship between the dependent variable and independent variable (Kothari, 2013; Bajpai, 2011).

6.4.5 Choice of research design in this study

The design chosen in this current project was exploratory research design. The problem will be explored to find out the solution. Exploratory research design will be offering aid in investigating the impact of VE methodology on the construction sector of the UAE. Here the effect will be the increasing costs of construction projects in the UAE which will be (potentially) decreased by using the VE methodology. The exploratory research design has been selected so that the best research design with effective data collection methods can be used for arriving at valid conclusions. Also, the exploratory research design has been chosen because it uses both primary and secondary research. In order to conduct the secondary research, past studies and the literature were reviewed. The primary research will be conducted with the help of survey and interviews. Exploratory research is flexible enough to address different types of research questions (Creswell, 2013).

6.5 Types of data

Mainly there are two types of data that can be selected for the purpose of performing the study. These are qualitative and quantitative data (Limat, 2016). A description of both types of methods is given below:

Qualitative data and approach: Qualitative research is an exploratory approach through which a deep analysis is done to get an insight into the issue. Qualitative research is selected when the topic needs high-quality responses. It is a non-numerical and descriptive type of research in which applied reasoning and uses of words are compulsory to get the results (Saunders, Lewis, & Thornhill, 2012). In this approach, the researcher finds out the answers of why and how of decision-making. If the research topic is related to the identification of the meaning and feeling of the situation, then this research technique is used. Qualitative research is conducted through many methods like in-depth interview, focus group (group discussion) and observation/participation (Creswell, 2013).

Quantitative data and approach: Quantitative research is related to the quantification of data. In this type of research, the data is generated in numeric form and the researcher tries to quantify the behaviours, attitudes and opinions of a sample size and possibly generalise the results on the whole population. The quantitative approach uses the following data collection methods: surveys (online,

paper, mobile and kiosk), face-to-face interview through questionnaire, online polls and systematic observation (Babbie, 2013).

Types of quantitative data

Quantitative data can be further classified as:

Nominal data: Nominal data is values that can be assigned a code in the form of a number where numbers are simply depicting labels. Nominal values are not quantitative in nature. The researcher can count the nominal values but not order or measure them; such as marital status, gender, eye colour, etc (Calkins, 2005).

Ordinal values: ordinal values have a rating scale attached to them and this rating scale can count or order the values but cannot measure non-numeric concepts such as happiness, satisfaction, discomfort, etc (Calkins, 2005).

Ratio value: Ratio value determines the relative sizes of different values. It is calibrated to compare different quantities of similar units. Moreover, it is used to identify values of different components in mixtures by representing the value of one quantity in relation to another quantity (Calkins, 2005).

Interval value: Internal value of data involves a deep analysis of different elements. This type of data can be measured through determining the internal process of the focused business operation (Calkins, 2005).

Categories of quantitative data

There are two different categories of quantitative data which are discrete and continuous:

Discrete data: Data is said to be discrete where measurements are there in integers (Calkins, 2005).

Continuous data: Continuous data is data where measurement is based on the basis of the value, wherein, data lies within a particular range (Calkins, 2005).

Data in this research

In this study, nominal quantitative data was collected from the target sample size. It is easy to change the nominal data into quantitative form in order to perform further calculation on it, which is why this method was chosen for collecting the data in this study. The flowchart of overall research methodology is presented in Figure 6.2.

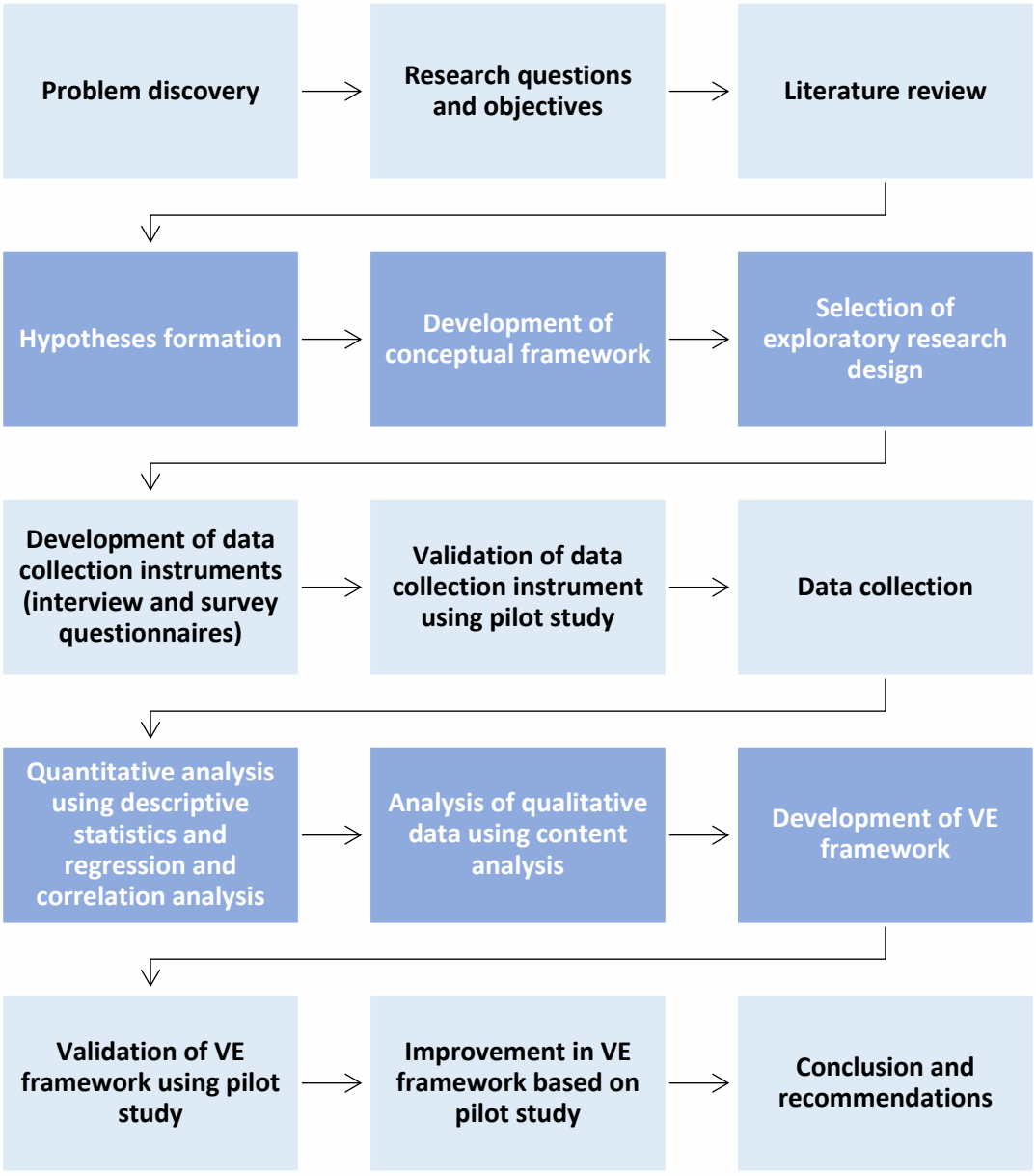

Figure 6.2: Flowchart research methodology

6.6 Research approaches associated with the different types of data

6.6.1 Quantitative method

Quantitative methods are numerical, statistical, and mathematical in nature. Quantitative methods are performed with the help of questionnaires, surveys, polls, or by the manipulation of already existing statistical data using computational techniques. Numerical data is gathered for conducting the quantitative method for understanding the group of people or gaining insight into the particular phenomenon (Limat, 2016).

The methodology of collecting quantitative data is as follows:

- Study population and sampling
- Data collection
- Data analysis

With the help of these methods, a quantitative study is performed (Limat, 2016). The following are the advantages of using this method:

- Using the quantitative method allows for a broader study as it involves a greater number of subjects.
- It is helpful in generalising the results.
- It allows for greater objectivity maintaining accuracy of results (Limat, 2016).

In this current study, quantitative research will be used in the form of a questionnaire to collect data on the connection between the independent and dependent variables.

6.6.2 Qualitative method

Qualitative studies emphasise the quality of entities and processes rather than including experimentally examined studies. This is contrary to quantitative studies. A vast amount of data is gathered in this type of research, which is not at all numerical (Limat, 2016).

The qualitative research is performed in the following sequence:

- Goals of the study
- Conceptual framework

- Research questions
- Methods
- Validity
- Conclusion (Limat, 2016)

The qualitative study can have the following advantages:

- It is helpful in obtaining a more realistic view of the problem that cannot be resolved using numerical data.
- It allows the researchers to get an insight into the existing phenomenon and existing situation.
- It is helpful in providing a holistic view of the phenomenon.
- It responds to the conditions and needs of the participants.

The qualitative method which will be used in this research is the review of literature (Limat, 2016) along with validating the results of the quantitative phase. Thereafter, the primary research will be qualitative as well as quantitative (mixed-methods), thus giving the benefits of both options.

6.7 Ethical approval

The 'Ethical Approval Form' (Appendix I) was completed before conducting the research to ensure that the research followed the ethical guidelines of the University. Ethical approval was granted before primary data were collected. The participants were asked to sign the consent form and participant information sheet to ensure that they are aware of the purpose of the research. Participants were assured of the anonymity of their identity and responses.

6.8 Data collection by questionnaire

The questionnaire method is preferred for collecting the responses of the real estate experts. In the survey questionnaire, Section A included demographic questions. Section B was prepared to measure dependent and independent variables – cost of production, competitive advantages, conflict avoidance, achievement of needs, affordability of housing, VE in design and procurement process, implementation of VE in UAE housing, and knowledge management in VE in UAE construction.

In the interviews, demographic questions were asked of the interviewees and various questions were asked of the participants regarding VE implementation in housing projects, major challenges associated with it so that some strategies could be suggested by them for improving the implementation of VM in UAE housing projects.

Design of the questionnaire

Questions asked were closed-ended, i.e. the respondents were given choices in answering the questions. This practice saves the time of the respondents as well. A Likert scale ranging from 1 to 5 will be used to take the responses of the real estate experts (Kothari, 2013); where 1 to 5 will indicate the following:

- 1 Strongly agree
- 2 Agree
- 3 Neutral
- 4 Disagree
- 5 Strongly disagree

The questionnaire will be distributed among respondents by mailing the same. They are supposed to complete the answers in the questionnaire sheet and send the responses back to the researcher.

The questionnaire included demographic as well as descriptive questions to be asked of the real estate experts. In the study, demographic questions related to the gender and age of the real estate experts had been asked. Education- and income-related questions had not been included as these questions were not supposed to impact on the outcome. Descriptive questions related to the main themes of the study based on independent variables were 'cost of production', 'competitive advantage', 'conflict avoidance', and 'achievements of needs' and 'affordability of housing'.

6.8.1 Pilot study

A pilot study involves data collection and analysis conducted on a small group of people for the purpose of investigating the feasibility of the study, adverse impacts, and statistical variability. It is an attempt to improve upon the study design (Rajasekar, Philominathan, & Chinnathambi, 2013). A pilot study was performed in the project to learn about the feasibility of the instrument.

A small sample size was used to perform the pilot study. Seven respondents were taken to conduct the pilot study. These respondents were experts from the real estate sector.

A questionnaire was administered to some experts and feedback was collected to identify any ambiguities and difficult questions. The time taken to complete the questionnaire was recorded and the questionnaire was arranged as per the reasonable time. The pilot study was conducted with seven VE experts. The following Table, 6.1, gives an account of the experts on whom the pilot study was conducted.

Table 6.1: Sample of experts in the pilot study

Designation	Number	Years of experience
Value engineer	3	3-5 years
Architect	2	7-9 years
Project manager	2	5-7 years

The questionnaire was sent to the participants through email and they were asked to respond within one week. The best part about the questionnaire was that the questions were easily understood by the respondents and all the questions were answered by them. Thus, the pilot study showed that the questionnaire was easy to answer and relevant enough to meet the research objectives.

Following the pilot, all the unnecessary, difficult and ambiguous questions were deleted from the final questionnaire. The original questionnaire consisted of a total of 105 questions, including 12 demographic questions and 93 specific questions, and the unnecessary questions were deleted to develop the final questionnaire which was used for the final study. The final version of the questionnaire, with a total of 95 questions, is provided in Appendix II.

6.8.2 Sampling

There are two types of sampling methods, namely probability sampling and non-probability sampling (Kremelberg, 2011). Probability sampling is that type of sampling in which data is collected from the respondents having equal chances of being selected (Kremelberg, 2011). Its options include simple random sampling; stratified sampling, systematic sampling, and cluster sampling, which are types of probability sampling.

Non-probability sampling is the opposite of probability sampling, in which respondents do not have an equal chance of being selected. Types of non-probability sampling are convenient sampling, snowball sampling, judgmental sampling, etc. (Rajasekar et al., 2013).

The sampling method can be defined as the method which is used to determine the best technique which can be used to determine the sample for the collection of data for the research. Sampling techniques include simple random sampling, stratified sampling, systematic sampling, cluster sampling and quota sampling. These are differentiated below (Thompson, 2012):
The different types of probability sampling methods discussed below are shown in Figure 6.3 (McCombes, 2019):

- **Simple random sampling:** This method of sampling technique provides an individual with an equal chance of being selected. This method reduces bias among the respondents and thereby simplifies the analysis of the results (McCombes, 2019).

- **Stratified sampling:** The stratified sampling technique involves the segmentation of the population on the basis of strata. This is a probability sampling technique through which respondents are selected randomly (McCombes, 2019).

- **Systematic sampling:** This sampling technique depends upon the arrangement of the population systematically. The systematic sampling is almost similar to the simple random sampling but it is easier to be conducted. In this context, each and every member of the population is listed with number and individuals are selected on the basis of regular intervals instead of random selection (McCombes, 2019).

- **Cluster sampling:** The cluster sampling technique involves the selection of people in groups. This method reduces the administrative cost (McCombes, 2019).

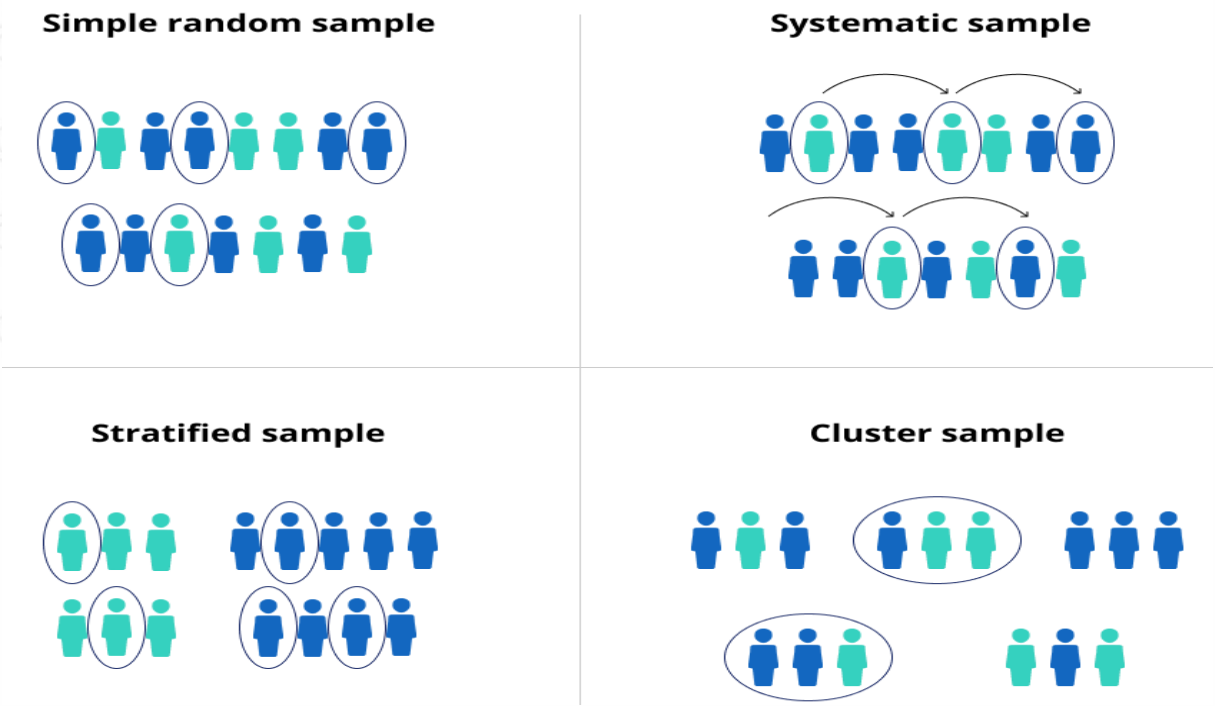

Figure 6.3: Probability Sampling illustrated

Source: (McCombes, 2019)

Non-Probability Sampling Methods

Figure 6.4 depicts different types of non- probability sampling methods in which individuals are selected on the basis of non-random criteria and because of this reason every individual does not have equal chance to get selected (Laerd, 2020).

Quota Sampling: In this method the sample in which the groups included reflect a certain proportion of the population being studied (Laerd, 2020).

Convenience Sampling: In this method the samples that can be easily accessed are selected (Laerd, 2020).

Purposive sampling: This is also known as judgemental, subjective or selective sampling method in which the sample selected is on the basis of the researcher's judgements. These judgements are influenced by the reasons for selecting the sample (Laerd, 2020).

Self-selection sampling: As the name suggests in this type of sampling method the individual or the organization is given the option to participate in the research process on their own will. This means that in this method the subjects volunteer to participate in the research study (Laerd, 2020).

Snowball sampling: This sampling method is usually adopted when the subjects are hidden or they are hard to reach like for example, drug addicts, people suffering through some illness, etc. (Laerd, 2020).

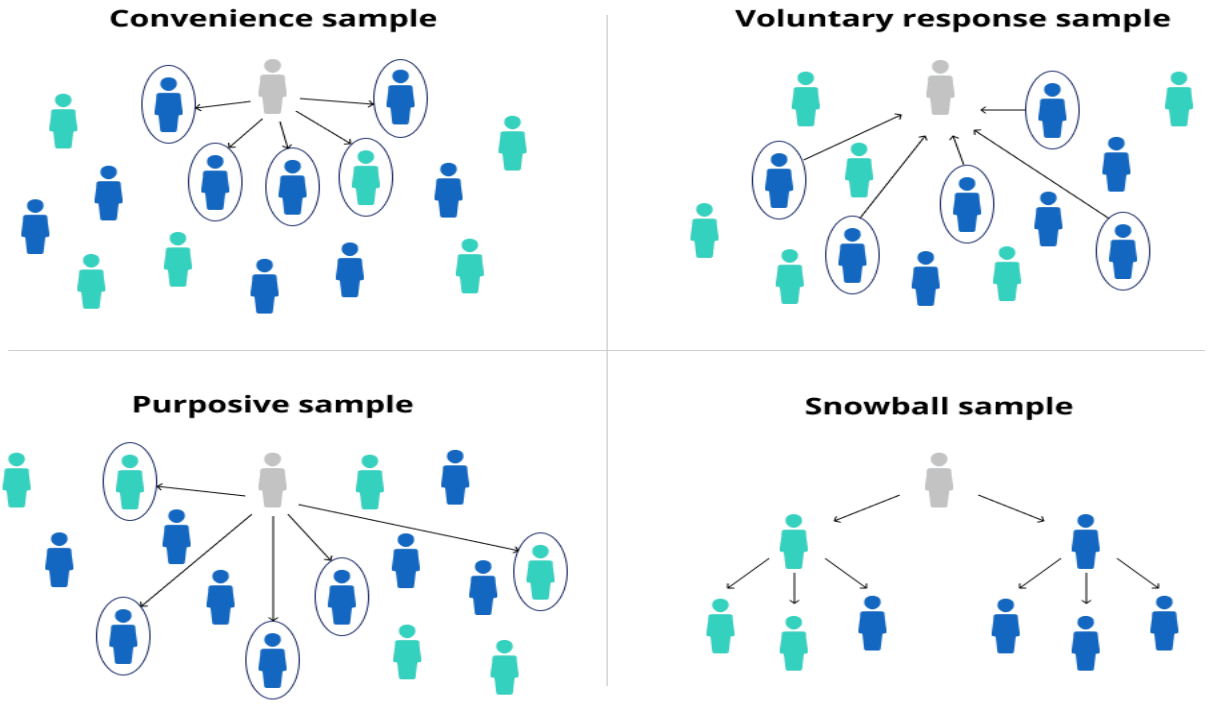

Figure 6.4: Non-Probability Sampling illustrated

Source: (McCombes, 2019)

Type of sampling chosen

In this study, the quantitative data was collected by using simple random sampling under probability sampling. The reason for choosing simple random sampling is that it is free from the errors of classification, so the result will also be more authentic and error-free. This sampling technique is totally free from bias and prejudice and is easy to use. If any error occurs in the data then it is very easy to access the sampling errors in this method (Bajpai, 2011). The simple random

sampling is simple and it helps the researcher in avoiding any unconscious bias that could be reflected in the data collected.

The simple random sampling is also associated with an equal chance of selection. This creates accuracy in the collected data as the ratio of opportunity is 50:50. Hence an inherent fairness will be built into the research. This is because no previous information about the items and individuals is included in the process of data collection (Creswell, 2013).

For the interviews however, the non-probability convenience sampling method was selected. The main reason of selecting convenience sampling method is that it saves a lot of time and money as compared to the probability sampling methods. This is the simplest sampling method and has very few rules attached to the manner in which it should be used. The convenience sampling method is believed to help in collecting relevant and accurate data as compared to probability sampling methods (Laerd, 2020).

6.9 Data collection method and phases

Data collection is a technique of collecting data for the purpose of conducting the research. There are two types of data collecting, i.e. primary data and secondary data.

- **Primary data** is that data which is collected through the concerned personnel. Primary data can be collected with the help of survey, observations, and focus groups (Limat, 2016). The description of each method of primary research is given below:
    - **Survey:** The survey is performed with the help of questionnaire and interview. In this method, data is directly collected by the participants. In the questionnaire, some questions are asked and respondents are supposed to fill in the questionnaire. In the interview method, some questions are asked of the participants and it ensures face-to-face communication of interviewer and interviewee (Limat, 2016).
    - **Observation:** In this method of primary research, data is collected either with respondents being aware of it or by not letting them know. Behaviour of the participants is observed under this method, and on the basis of the same, data is obtained (Kothari, 2013).

- **Focus group:** In a focus group, opinions, beliefs, and ideas of the participants are explored for collecting the data. For instance, before launching a product, a focus group can be used for taking responses regarding the product to be launched (Kothari, 2013).

- **Secondary data** is collected by a review of literature. Secondary data is collected with the help of journal articles, books, magazines, newspapers, conference proceedings, government reports, etc.

In the study, both methods of data collection will be used. Primary research will initially be performed by survey using the questionnaire method.

6.9.1 Phases of data collection

There are six specific steps for collecting the data in research projects. The data was collected in the following manner:

1. Identifying the issue
2. Selecting the goals and objectives
3. Selecting approach and methods
4. Collecting data
5. Analysing and interpreting data
6. Acting on results

All the steps will be described one by one:

- First of all, the issue or problem is identified in a bid to explore it further. The issues can be related to employees, management, leaders, or anything else. In the study, the issue is related to the construction sector of UAE.

- The next step is to make objectives and goals for the purpose of understanding the issue and defining the scope of the study. The aim of the study is to reduce the huge costs incurred on the construction projects.

- After that, approaches and methods are to be selected with which the research is to be performed. Inductive and deductive approaches are used in the project. The methods

chosen are both qualitative and quantitative. Data collection will be done by performing a survey on the real estate experts.

- The next step is interpretation of data. Data analysis will be done by first visualising the results through tables and charts. Other statistical techniques are then employed in the data analysis. Secondary results have been analysed by sharing personal opinions on the same.

- Lastly, results are inferred from the data collection (Rajasekar, Philominathan, & Chinnathambi, 2013).

6.9.2 Data analysis

Data analysis is used for interpreting the results from the data collected. There are different forms of analysing the data such as descriptive, exploratory, inferential, predictive, casual and mechanistic. In this research study, tables and pie charts are used to analyse the data. Through this process of data analysis in the research study, a vast amount of descriptive information is gathered from different sources which offer an explanation and interpretation of the results related to the study, that rely on the systematic report in the structured and transparent form. This method of analysis has great significance in the research study to get the approximate solution for the research problem.

There are many tools which are used for interpreting the data. Some of these techniques that may be relevant for analysing the questionnaire data are descriptive statistics, regression, and Spearman's correlation. Spearman's correlation was used to find an association between dependent and independent variables of the study. Regression analysis was utilised to establish the relationship between dependent and independent variables (Kremelberg, 2011).

Choice of data analysis technique for the study

The data analysis tool used in this research will be the regression and correlation analysis. Correlation analysis is suitable for this research as it helps in measuring the strength of linear relationship between two variables. To test the hypothesis and identify the numerical relationship between the variables, regression can be used (Vik, 2014). Regression analysis will be performed

on the collected data, as this research was based on the relationship among different variables (Draper & Smith, 2014). As both the independent and dependent variables are ordinal, the method for analysis will be ordinal multiple regression. From this regression analysis, the relationship between the dependent and independent variables will be identified. Microsoft Excel will be used for collating initial responses and depicting the opinions of the respondents by using frequency tables. Visualisation will be done by pie charts and bar graphs (Kremelberg, 2011). With the help of data analysis tools such as regression or correlation, it will then be investigated whether the null or alternate hypotheses will be accepted.

6.10 Validity and reliability

Reliability refers to the degree of consistency of an instrument used to measure the attribute of a research study (Kothari, 2013). The reliability of the research study can be ensured by reducing the measurement error. If the results of the research study are reliable, it would mean that the same results can be obtained if the study is replicated by another researcher using the same method of conducting the research. In order to enhance the reliability of the data collection instrument, appropriate questions were asked in the interview to facilitate the respondents' comprehension of the problems of the research study.

In addition, validity of the data is concerned with the meaningfulness of the research components (Kothari, 2013). Validity of research is categorised into two parts, i.e. internal validity and external validity. Validity of a report determines whether the research study measures the accurate results which it was intended to measure, and whether these results are truthful in nature or not (Kothari, 2013).

Both reliability and validity of the report are determined in order to investigate both qualitative and quantitative results of the study. These measurements of data confirmation identify the reliability and accuracy of the evaluated results (Kumar, 2014).

There are three basic types of validity in research, including content validity, construct validity and criterion validity. **Content validity** is the extent to which the selected research instrument measures all aspects of construct accurately; **construct validity** highlights the extent to which a research instrument measures the intended construct; and **criterion validity** is the extent to which

a research instrument is relayed to other instruments which measure the same variables (Kumar, 2014). In this research, the content validity has been established. For establishing the content validity in this research, questionnaire which has been used for the research was prepared from the standard questionnaires. Also, the prepared questionnaire was sent to the experts for validation. The necessary changes were made to the questionnaire based on 'suggestions given by experts' (Heale & Twycross, 2015). The validations of the survey and interview questions were performed by experts who included a value engineer, architect and a project manager. The value engineer has minimum experience of 3 to 5 years while the architect has the minimum working experience of 7 to 9 years. Similarly, the project manager has the minimum working experience of 5 to 7 years. All these experts had experience in construction work and were associated with the relevant field of the research study for several years. These experts were suitable for validating the questionnaire prepared for the research purpose (Refer to Table 6.1). So, a total of three experts were included in the process of validating the questionnaires with a minimum and maximum experience of 3 and 9 years respectively.

Reliability can be described as the consistency of a measure. There are three major types of reliability, including **homogeneity**, which is the extent to which all the items present on a scale measure a single construct; **stability**, which establishes consistency of results using an instrument with repeated testing, and **equivalence**, which establishes consistency among the responses of multiple users of an instrument (Kumar, 2014). For measuring the homogeneity or internal consistency of the instrument, Cronbach's alpha was used where; consistency is considered to be reliable if its score is 0.7 or higher. The following formula will be used for the calculations related to Cronbach's alpha (Kumar, 2014):

Where:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\Sigma Vi}{Vtest}\right)$$

- N is the number of questions
- V_i is the variance of scores on each question
- V_{test} is the total variance of overall scores on the entire test

Cronbach's alpha coefficient was used to establish the reliability of the data as it is considered to be the easiest and most reliable method for checking the internal consistency of the data. The value of the Cronbach's alpha coefficient obtained for the data pertaining the constructs in the research ranged from 0.839 - 0.957, as shown in Table 6.2. This shows that the research instrument

developed was reliable (Heale & Twycross, 2015) as all scores exceeded 0.7. The results obtained from applying the foregoing chosen techniques are discussed in the next chapter.

Table 6.2: Reliability statistics

No	Construct	Cronbach's alpha	Number of items
1	Cost of production	.839	6
2	Competitive advantage	.868	8
3	Conflict avoidance	.957	15
4	Achievements of needs	.876	6
5	Affordability of housing	.845	7

6.11 Summary of Chapter 6

The chapter gave a brief overview of the research methodology to be used in the project. The study involved using mixed-methods. Primary and secondary data were collected for reaching the conclusions of the study. Primary data was collected using surveys and interviews. Sources of secondary data were mainly a review of literature. The sample of primary data providers consisted of real estate experts. The sampling methodology preferred in the project was probability sampling rather than non-probability sampling. A total of 95 closed-ended questions were included in the survey questionnaire and 14 interview questions in the study. The analysis and interpretation of the data will be done by Microsoft Excel. Results will first be visualised through tables and charts and then by using more rigorous inferential statistics.

CHAPTER 7 – QUANTITATIVE DATA ANALYSIS, RESULTS AND DISCUSSION

7.1 Introduction to Chapter 7

The cost of housing projects in the United Arab Emirates is increasing: one of the reasons behind this can be the use of traditional methods in the construction of housing projects. Apart from the cost issues, the construction industry of UAE is also facing the issue of delays. Quality, cost and timely delivery of the projects are the pillars of the construction industry. The UAE's construction industry is failing to achieve its basic objectives. This research therefore focuses on VE that can be used to achieve the objectives of quality, cost and timely delivery. It is essential for the UAE construction industry to employ modern methods in construction rather than depending only on traditional methods.

VE in design has been combined with VE in the procurement process to analyse the overall correlation of VE and its variables with cost of production, competitive advantage, conflict avoidance, achievement of need, and affordability of housing, as indicated in the conceptual framework in Section 5.7. There are two independent variables, namely VE in procurement and VE in design. The impacts of these two variables on the dependent variables are being analysed due to their increasing importance in the construction industry (McGinnis, 2005). For instance, the conceptual framework posited that material, plant and labour affect the construction of any place; and waste is also generated in construction. These factors can be managed properly through VE. Similarly, the competitive advantage of the company, cost of production and conflict avoidance are also dependent on VE and value procurement (Park, 1998). Value procurement is also a necessary aspect of VE and is included in it. VE helps the procurement managers in determining alternative materials for cost and quality efficiency and helps them to buy the raw materials at the correct time and within the determined costs. All these things help in constructing a valuable structure or design. With the increase in emphasis on value creation in design, it has become important to integrate the VE in procurement with VE in design, as the designing depends on procurement of raw materials and its utilisation to generate the least amount of waste (McGinnis, 2005).

The major aim of this research is to determine how VE can be integrated with construction industry practice in the UAE. To assess how VE can be integrated with the construction industry in the UAE, data was collected in the form of various variables. The data was collected from 102 people by conducting a survey. The questions asked in the survey are provided in Appendix I.
The following sections will discuss more about the data and their methods of analysis. The last section of this chapter will discuss the findings and conclusions drawn.

7.2 Data and analysis methods chosen

The responses to the questions asked were captured in the form of a 5-point Likert scale (strongly disagree, disagree, neutral, agree, and strongly agree).

Since it will not be possible to analyse the data available in the form of strongly disagree, disagree, neutral, agree, and strongly agree, therefore, the responses captured will be converted thus: strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5, as doing this we will be able to analyse the data statistically.

In order to check whether there is any relationship between the variables of the study, i.e.:

- VE in design & procurement process
- Cost of production
- Competitive advantage
- Conflict avoidance
- Achievements of need
- Affordability of housing

The following two techniques have been used to assess the relationship between the variables of the study, i.e.:

- Ordinal logistic regression
- Spearman's rho correlation

7.2.1 Ordinal logistic regression

All the independent variables are ordinal and the nature of the dependent variable is ordinal as well. Therefore, the method for analysis with which to proceed is ordinal multiple regression. This regression analysis will establish the relationship between the dependent and independent variables.

The model for ordered logistic regression is:

$\text{Log}_e\left(\frac{\pi_i^{(j)}}{\pi_i^{(0)}}\right) = \beta_0^{(j)} + \beta_1^{(j)} X_{1i} + \ldots\ldots + \beta_k^{(j)} X_{ki}$, (Bryman & Bell, 2015) where,;

- I = 1, 2,….,n; j=0, 1, 2,…., c-1
- $X_1, X_2, \ldots, X_k$ are k explanatory variables (Bryman & Bell, 2015)
- $\pi_i^{(0)}, \pi_i^{(1)}, \pi_i^{(2)}, \ldots\ldots\ldots\ldots\ldots, \pi_i^{(c-1)}$ are the probability parameters
- $\beta_0^{(j)}$ and $\beta_1^{(j)}$, ……., $\beta_k^{(j)}$ are unknown population parameters.

The pair of overarching hypotheses was defined as:

Null hypothesis:

H_0: The regression coefficients in the model are equal to zero.

Alternative hypothesis:

H_1: At least one of the regression coefficients in the model is not equal to zero.

Meanwhile, the respective hypotheses tested under this broad 'Null & Alternative' hypotheses were identified in section 5.7.1. In these considerations, the independent variables are 'VE in design' and 'VE in the procurement process' and the dependent variables are 'cost of production', 'competitive advantage', 'conflict avoidance', 'and achievements of needs' and 'affordability of housing'.

The testing of the hypothesis was conducted at a 5% level of significance, i.e. if the p-value is less than the 0.05 then we will reject the null hypothesis and accept the alternative, or vice versa. The 5% level of significance chosen for this research indicates that there is a 5% risk of concluding that a difference might exist when there is actually no significant difference, which is less acceptable.

7.2.2 Spearman's rho correlation

Since, the data so collected are in the form of a Likert scale and ordinal, it is suitable to use non-parametric correlation, i.e. Spearman's rho correlation, to find out the correlation between 'VE in design & procurement process' and 'cost of production', 'competitive advantage', 'conflict avoidance', 'achievements of needs' and 'affordability of housing'. It is known that correlation can help in assessing the association between the two sets of variables. Here, the objective of the study is to assess if there is any association between the questions from 'VE in design & VE in the procurement process' and 'cost of production', 'competitive advantage', 'conflict avoidance', 'and achievements of needs' and 'affordability of housing'.

Strength of association criteria

Table 7.1 has been used as a reference guide to assess the strength of the association between the variables (Bryman & Bell, 2015):

Table 7.1: Reference table
Source: (Bryman & Bell, 2015)

Strength of association	Positive	Negative
Small	0.1 to 0.3	-0.1 to -0.3
Medium	0.3 to 0.5	-0.3 to -0.5
Large	0.5 to 1.0	-0.5 to -1.0

7.3 Data analysis, results and discussion

After running both the analyses, it was observed that the results for ordinal logistic regression show that the overall model is significant, i.e. there is impact of the two independent variables 'VE in design' and 'VE in the procurement process' on the dependent variables 'cost of production', 'competitive advantage', 'conflict avoidance', 'achievements of needs' and 'affordability of housing'. However, when the analysis was done to see which of the independent variables have impact on the dependent variable, then it was observed that none of the independent variables are significant which may be due to the nature of the data.

The results of Spearman's rho correlation were pretty clear and reliable. Therefore, discussion will be made on the results obtained using Spearman's rho correlation.

This section contains the results obtained by performing the analysis of the data and discussion about the results so obtained.

7.3.1 Descriptive statistics

The following figures/tables represent the summary of the gender, designation, age and the other variables such as VE in design in procurement process, cost of production, competitive advantage, conflict avoidance, achievements of needs and affordability of housing.

From Figure 7.1, it can be seen that the number of female participants is 26 (25.5%) while the number of male participants is 76 (74.5%).

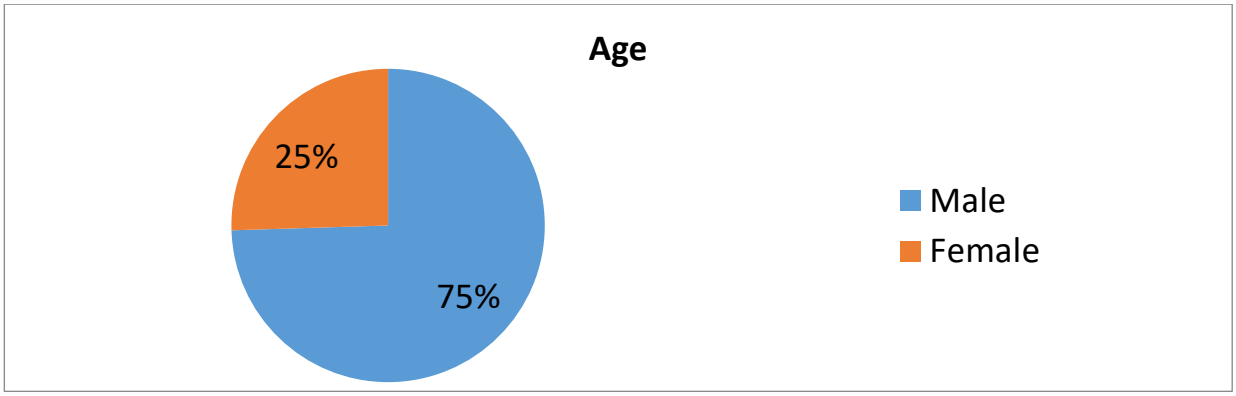

Figure 7.1: Gender distribution

From Table 7.2, it can be seen that the number of participants working as executive is 12 (11.8%), as manager is 44 (43.1%), as senior manager is 30 (29.4%), and working on other designation is 16 (15.7%).

Table 7.2: Respondents' job titles

	Frequency	Per cent
Executive	12	11.8
Manager	44	43.1
Senior manager	30	29.4
Other	16	15.7

From Figure 7.2, it can be seen that the tenure of participants working with their present organisation for <1 year is four (3.9%), for 2-5 years is 22 (21.6%), for 6-10 years is 40 (39.2%), and for >10 years is 36 (35.3%).

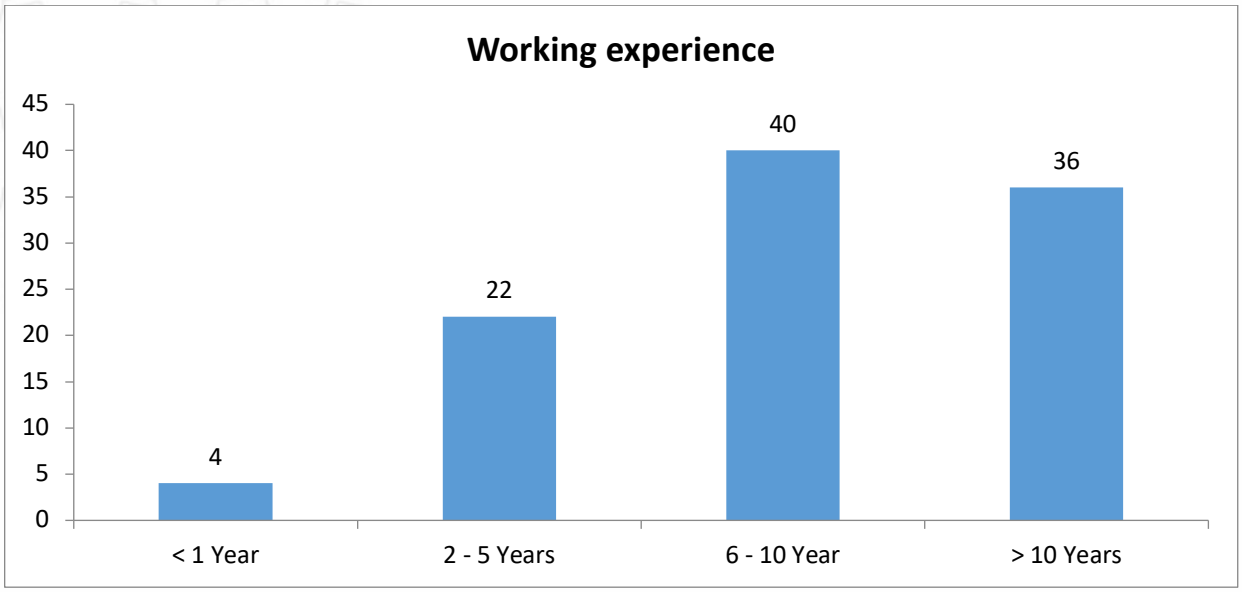

Figure 7.2: Working experience in present organisation

From Table 7.3, it can be seen that the number of participants between the ages of 20 and 30 is eight (7.8%), between the ages 31 and 40 is 50 (49.0%), between the ages 41 and 50 is 30 (29.4%), and above age 50 is 36 (13.7%).

Table 7.3: Age distribution of respondents

	Frequency	Per cent
20 – 30	8	7.8
31 – 40	50	49.0
41 – 50	30	29.4
Above 50	14	13.7

From Figure 7.3, it can be seen that the number of participants with the highest educational qualification as undergraduate is two (2.0%), as graduate is 44 (43.1%), as master's is 46 (45.1%), and as PhD is 10 (9.8%).

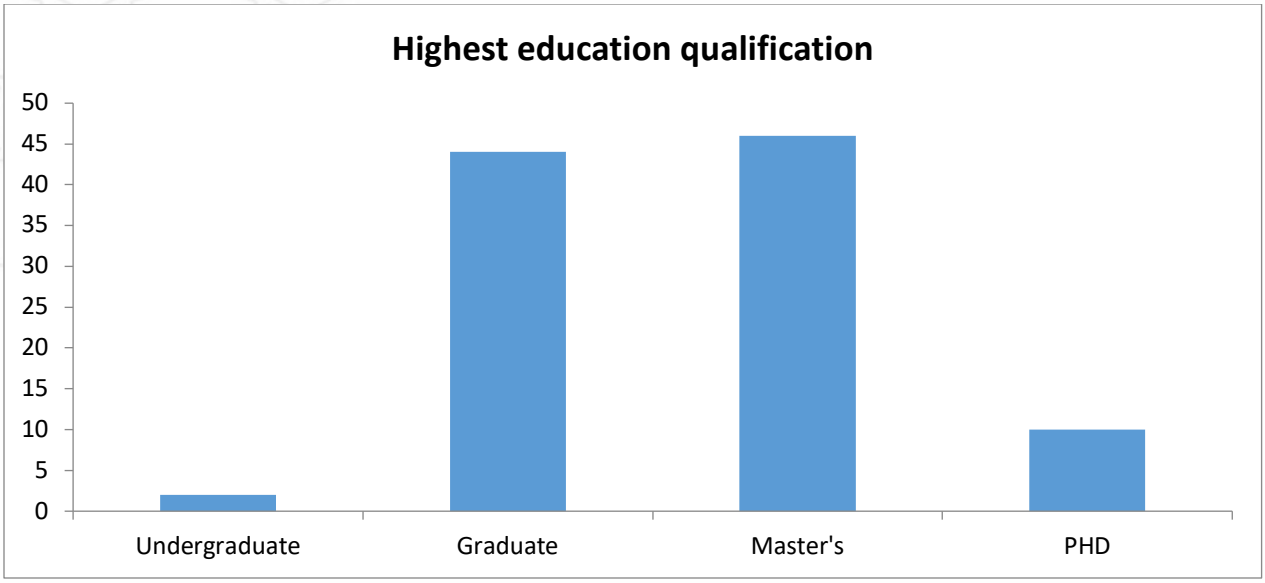

Figure 7.3: Respondents' highest level of education

From Table 7.4, it can be seen that the number of participants who have participated in VE (VE) before is 88 (86.3%).

Table 7.4: Participation in VE by respondents

	Frequency	Per cent
No	12	11.8
Yes	88	86.3
Missing	2	2.0

7.4 Results of Spearman's rho correlation

Tables 7.5 and 7.6 represent the summary of correlation between the dependent variables – 'cost of production', 'competitive advantage', 'conflict avoidance', 'achievements of needs', and 'affordability of housing' – and independent variables – 'VE in design' and 'VE in procurement process'.

The G1 to G9 values signify the values of the stated variables for the sub-questions related to VE in the process of procurement:

- G1 states that VE helps in the identification of alternative materials for the projects.

- G2 states that VE helps in determining the optimum quantity of materials which are to be ordered.
- G3 means that VE focuses on the resource optimisation.
- G4 states that VE helps in timely procurement of the materials.
- G5 states that VE helps in procurement of materials within the right cost.
- G6 states that VE helps in reduced wastage of materials.
- G7 states that VE works well with traditional form of procurement.
- G8 states that VE works well with 'design & build' procurement.
- G9 states that VE works well with raw material procurement.

The singular values for each variable have been obtained by finding out the mean or average of all the obtained responses under each variable (Höskuldsson, 1988). The reason for establishing the singular values was to get an idea about the overall responses provided by the respondents for each variable. For example, if the singular variable for any variable is greater than 0.4, it means that most of the respondents agree with the statements formulated under that variable.

From Table 7.5 it can be seen that there is a positive correlation between all the questions of 'VE in the procurement process' and the question of 'cost of production'. The correlation suggests that there is a strong correlation between the statements that 'VE uses the less expensive alternate materials in designing' and 'VE works well with design and build procurements' (0.808). It indicates that VE works well with the design and build procurements and therefore, it promotes using less expensive alternate materials in designing in a significant amount. Similarly, there is a significant correlation between 'VE critically analyses the processes of housing construction so that cost can be reduced at each of the project phases' and 'VE helps in procuring materials at the right cost' (0.468). It suggests that if the raw materials are procured at reduced rates, the housing construction can be completed at reduced costs (Smith & Freeman, 2014). These examples indicate clearly that the VE in procurement process helps in reducing the costs of production.

However, there is a weak correlation between 'VE helps in reducing the cost of production' and 'VE helps in deciding the optimum quantity of the materials to be ordered'.

Table 7.5: Correlation between 'VE in the procurement process' and 'cost of production'

		G1	G2	G3	G4	G5	G6	G7	G8	G9
A1	Correlation coefficient	.572**	.477**	.672**	.691**	.351**	.512**	.614**	.808**	.709**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
A2	Correlation coefficient	.516**	.425**	.463**	.347**	.334**	.407**	.444**	.364**	.468**
	Sig. (2-tailed)	.000	.000	.000	.000	.001	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
A3	Correlation coefficient	.436**	.307**	.453**	.573**	.356**	.461**	.536**	.526**	.522**
	Sig. (2-tailed)	.000	.002	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
A4	Correlation coefficient	.450**	.351**	.567**	.671**	.468**	.527**	.453**	.553**	.598**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
A5	Correlation coefficient	.513**	.367**	.575**	.518**	.592**	.640**	.570**	.499**	.466**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
A6	Correlation coefficient	.419**	.239*	.459**	.544**	.555**	.488**	.517**	.415**	.385**
	Sig. (2-tailed)	.000	.016	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
(Bryman & Bell, 2015)

The result shown in Table 7.6 indicates that there is a positive correlation between all the questions of 'VE in the procurement process' and the question of 'competitive advantage'. The value of correlation is 0.643, which means that there is a significant correlation between 'VE helps in procuring materials at the right time' and 'VE helps in the timely completion of projects'. It means that if the raw materials are procured at the correct time through VE, the projects will be completed at the correct time. It gives the organisations competitive advantage over others (Sharma & Kumar, 2017). It suggests that the correlation between VE and competitive advantage is significant.

Similarly, the correlation between B7 and G9 (0.623) suggests that VE works well with the procurement of the raw materials, which helps in providing robust designs.

Table 7.6: Correlation between 'VE in the procurement process' and 'competitive advantage'

		G1	G2	G3	G4	G5	G6	G7	G8	G9
B1	Correlation coefficient	.422**	.263**	.512**	.436**	.290**	.266**	.514**	.524**	.509**
	Sig. (2-tailed)	.000	.007	.000	.000	.003	.007	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B2	Correlation coefficient	.436**	.323**	.469**	.610**	.474**	.499**	.523**	.481**	.503**
	Sig. (2-tailed)	.000	.001	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B3	Correlation coefficient	.587**	.462**	.590**	.643**	.415**	.484**	.562**	.613**	.674**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B4	Correlation coefficient	.476**	.333**	.458**	.619**	.586**	.530**	.522**	.470**	.568**
	Sig. (2-tailed)	.000	.001	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B5	Correlation coefficient	.413**	.310**	.454**	.604**	.334**	.430**	.528**	.582**	.567**
	Sig. (2-tailed)	.000	.002	.000	.000	.001	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B6	Correlation coefficient	.399**	.349**	.424**	.456**	.376**	.361**	.563**	.503**	.451**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B7	Correlation coefficient	.617**	.445**	.566**	.605**	.442**	.446**	.591**	.623**	.623**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
B8	Correlation coefficient	.380**	.409**	.469**	.587**	.500**	.622**	.616**	.559**	.545**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
(Bryman & Bell, 2015)

However, there is a weak correlation between 'VE contributes in customising designs for construction according to customers' needs' and 'VE helps in deciding the optimum quantity of the materials to be ordered (0.263)', 'VE contributes in customising designs for construction

according to customers' needs' and 'VE helps in procuring materials at the right cost' and VE contributes in customising designs for construction according to customers' needs' and 'VE prevents the wastage of materials'.

From Table 7.7, it can be seen that there is a positive correlation between all the questions of 'VE in the procurement process' and the question of 'conflict avoidance'. For instance, the correlation between B4 and G4 is significant (0.681), which indicates that VE helps in timely procurement of raw materials, which helps in cutting down the unnecessary lines of communication. This has also been proven through the study of the literature (Heralova, 2016), where it has been stated that VE focuses on maintaining direct communication of the value engineers with the suppliers and professionals of their own company. This direct communication prevents the wastage of time and unnecessary conflicts, and ensures that the raw materials are received at the correct times (Heralova, 2016). Similarly, there is a high correlation between G8 and C13 (0.722) which indicates that 'VE works well with 'design & build' procurement' and thus, helps in improving safety.

Table 7.7: Correlation between 'VE in the procurement process' and 'conflict avoidance'

		G1	G2	G3	G4	G5	G6	G7	G8	G9
C1	Correlation coefficient	.412**	.228*	.355**	.490**	.331**	.367**	.314**	.515**	.474**
	Sig. (2-tailed)	.000	.021	.000	.000	.001	.000	.001	.000	.000
	N	102	102	102	102	102	102	102	102	102
C2	Correlation coefficient	.278**	.252*	.311**	.496**	.216*	.369**	.423**	.533**	.527**
	Sig. (2-tailed)	.005	.011	.001	.000	.029	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C3	Correlation coefficient	.454**	.330**	.464**	.581**	.383**	.513**	.494**	.552**	.623**
	Sig. (2-tailed)	.000	.001	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C4	Correlation coefficient	.595**	.460**	.610**	.681**	.544**	.573**	.620**	.609**	.637**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C5	Correlation coefficient	.630**	.437**	.587**	.656**	.520**	.557**	.677**	.641**	.637**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102

C6	Correlation coefficient	.617**	.430**	.562**	.564**	.496**	.601**	.623**	.628**	.583**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C7	Correlation coefficient	.499**	.496**	.517**	.694**	.530**	.663**	.632**	.695**	.628**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C8	Correlation coefficient	.448**	.384**	.415**	.567**	.469**	.543**	.671**	.617**	.640**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C9	Correlation coefficient	.548**	.465**	.515**	.613**	.444**	.562**	.620**	.709**	.711**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C10	Correlation coefficient	.685**	.492**	.613**	.555**	.598**	.648**	.646**	.746**	.752**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C11	Correlation coefficient	.695**	.508**	.610**	.469**	.551**	.615**	.641**	.673**	.736**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C12	Correlation coefficient	.458**	.459**	.512**	.476**	.429**	.529**	.675**	.567**	.595**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C13	Correlation coefficient	.718**	.467**	.604**	.601**	.626**	.626**	.659**	.722**	.730**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C14	Correlation coefficient	.715**	.557**	.638**	.612**	.579**	.660**	.674**	.654**	.659**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
C15	Correlation coefficient	.557**	.472**	.547**	.589**	.467**	.516**	.654**	.642**	.613**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
(Bryman & Bell, 2015)

However, there is a weak correlation between 'conflicts between participants in VE do reduce the quality of housing projects' and 'VE helps in deciding the optimum quantity of the materials to be ordered', 'conflicts between participants in VE do increase the time for completing housing projects' and 'VE in the procurement process', 'conflicts between participants in VE do increase the time for completing housing projects' and 'VE helps in deciding the optimum quantity of the materials to be ordered' and 'conflicts between participants in VE do increase the time for completing housing projects' and 'VE helps in procuring materials at the right cost'.

From Table 7.8, it can be seen that there is a positive correlation between all the questions of 'VE in the procurement process' and the question of 'achievement of needs' and there is no weak correlation. The correlation between VE and achievement of needs is significant. For instance, the correlation between D5 and G7 is significant (0.697) which states that VE works well with the traditional forms of procurement easily and it makes it easy to make changes in the project at any time. Similarly, the correlation between D4 and G1 is significant (0.689), which states that the increase in the efficiency of identifying the alternative materials for projects through VE also increases the efficiency of construction phases by using the latest facts for action. The VE in procurement helps the designers to enhance and refine their concept of designs and materials based on the latest facts (Sherwin, 1968; Rane & Attarde, 2016).

Table 7.8: Correlation between 'VE in the procurement process' and 'achievement of needs'

		G1	G2	G3	G4	G5	G6	G7	G8	G9
D1	Correlation coefficient	.621**	.421**	.552**	.517**	.455**	.484**	.494**	.667**	.581**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
D2	Correlation coefficient	.458**	.507**	.546**	.581**	.509**	.538**	.657**	.695**	.660**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
D3	Correlation coefficient	.573**	.402**	.558**	.553**	.477**	.550**	.595**	.554**	.570**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
D4	Correlation coefficient	.689**	.483**	.675**	.584**	.512**	.536**	.559**	.526**	.600**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
D5	Correlation coefficient	.419**	.372**	.536**	.593**	.444**	.627**	.697**	.696**	.691**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
D6	Correlation coefficient	.487**	.450**	.544**	.616**	.392**	.556**	.625**	.653**	.646**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
(Bryman & Bell, 2015)

Table 7.9 shows that there is a positive correlation between all the questions of 'VE in the procurement process' and the question of 'affordability of housing' and there is no weak correlation. For instance, the correlation between E1 and G4 (0.697) suggests that VE increases the efficiency of procuring the raw materials at the correct time and cost and therefore, also increases the affordability of the housing projects by reducing the expenses in a significant amount. Similarly, the correlation between G3 and E2 (0.552) indicates that an increase in the resource optimisation using VE also results in an increase in the cost management and control. This statement can also be validated through the literature review, where it is stated that VE helps in cost management and control in the construction projects (Value Eng, 2016).

Table 7.9: Correlation between 'VE in the procurement process' & 'affordability of housing'

		G1	G2	G3	G4	G5	G6	G7	G8	G9
E1	Correlation coefficient	.510**	.455**	.521**	.697**	.466**	.511**	.423**	.580**	.564**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
E2	Correlation coefficient	.535**	.504**	.552**	.520**	.536**	.599**	.581**	.560**	.668**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
E3	Correlation coefficient	.435**	.508**	.536**	.474**	.429**	.593**	.525**	.407**	.474**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
E4	Correlation coefficient	.430**	.452**	.432**	.428**	.403**	.553**	.529**	.475**	.521**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
E5	Correlation coefficient	.350**	.302**	.431**	.338**	.360**	.404**	.465**	.345**	.315**
	Sig. (2-tailed)	.000	.002	.000	.001	.000	.000	.000	.000	.001
	N	102	102	102	102	102	102	102	102	102
E6	Correlation coefficient	.382**	.412**	.422**	.556**	.453**	.541**	.537**	.445**	.548**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	102	102	102	102	102	102	102	102	102
E7	Correlation coefficient	.436**	.363**	.460**	.392**	.356**	.418**	.563**	.454**	.524**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000
	N	100	100	100	100	100	100	100	100	100

7.5 Discussion of results

7.5.1 VE in design and the procurement process and cost of production

From Table 7.10, it can be inferred that there is a significant positive correlation between VE in design and procurement process and cost of production. In other words, VE in design and procurement process may lead to a reduction in cost of production. This outcome suggests that the dual hypotheses of H1 and H6 (of section 5.7.1) should be accepted.

VE is one of the most powerful tools that help in achieving customer satisfaction and cost reduction. The procurement decisions are the most important decisions. For generating short lifecycles, targeted and fast procurement decisions are essential. The VM approach helps in enabling organisations to reduce their costs at the initial stage (Sharma & Kumar, 2017). Especially under difficult economic conditions, procurement is required to intensify its differentiated communication with suppliers, service providers and professionals within its own company. The approach of VE is gaining great importance as it influences the costs to a great extent. In addition, this approach helps in producing products that are not affected adversely (Heralova, 2016). The deployment of VE approaches will help the procurement department extend its possibilities to leverage long-term measures. With the VE approach, the procurement department, along with its decision-makers, has to face several challenges that arise from the untouched business processes. Hence, it can be indicated that the approach of VE is becoming vital for companies, as it sustainably influences the cost even at the early stage of a project. At the same time, reliability, quality, and marketability of the construction project is not affected adversely (Al-Yousefi, 2012).

7.5.2 VE in design and procurement process and competitive advantage

From Table 7.10, it can be inferred that there is a significant positive correlation between VE in design and procurement and competitive advantage. In other words, VE in design and VE in the procurement process may be associated with increased competitive advantage. This outcome suggests that the dual hypotheses of H2 and H7 (of section 5.7.1) should be accepted.

A competitive advantage is the ability of an organisation to perform differently from its competitors. A successful approach of VE requires a team that is cross-functional. A cross-functional team should include procurement experts, R&D experts, quality control experts and

production experts (Sharma & Kumar, 2017). The suppliers should also be involved in the initial phases of implementation of the VE approach. The VE approach when combined with procurement and manufacturing techniques allows an organisation to realise its full potential, which in turn helps in gaining a competitive advantage. The findings of the study by Tohidi (2010) indicate that one of the major roles of VE is to reduce the overall cost in the initial stages of the construction project. Hence, VE supports the competitive advantage by reducing the cost.

Table 7.10: Spearman's rho correlation between dependent and independent variables

VE in design and procurement process			
Spearman's rho	Cost of production	Correlation coefficient	**.830****
		Sig. (2-tailed)	**.000**
		N	**102**
	Competitive advantage	Correlation coefficient	**.821****
		Sig. (2-tailed)	**.000**
		N	**102**
	Conflict avoidance	Correlation coefficient	**.853****
		Sig. (2-tailed)	**.000**
		N	**102**
	Achievement of needs	Correlation coefficient	**.863****
		Sig. (2-tailed)	**.000**
		N	**102**
	Affordability of housing	Correlation coefficient	**.823****
		Sig. (2-tailed)	**.000**
		N	**102**

7.5.3 VE in design and procurement process and conflict avoidance

From Table 7.10, it can be inferred that there is a significant positive correlation between conflict avoidance and both VE in design and VE in the procurement process. In other words, VE in design and procurement process may reduce conflicts during the construction project (Sharma & Kumar, 2017). This outcome suggests that the dual hypotheses of H3 and H8 (of section 5.7.1) should be accepted.

VE is a systematic and function-oriented approach which is used for the overall study of a product or system. The VE approach focuses on the clarification of goals, objectives, roles and responsibilities. This is one of the best strategies that can be used for avoiding conflicts in a VE project. As conflicts are also avoided in projects that implement VE the customers get what they

demanded. There is a significant relationship between the achievement of needs and both VE in design and VE in the procurement process . VE in design and procurement process does help in the achievement of needs (Austin & Thomson, 1999).

7.5.4 VE in design and procurement process and achievement of needs

From Table 7.10, it can be inferred that there is a significant positive correlation between VE in design and procurement process and fulfilment of the needs of the customers/buyers. This outcome suggests that the dual hypotheses of H4 and H9 (of section 5.7.1) should be accepted.

Customers, while purchasing a house, look for quality, functionality, and price. The process of VE in construction projects helps in streamlining the operations, reducing the costs, and improving quality and functionality. In addition, VE also offers an opportunity to promote innovation and creativity (Al Ahbabi, 2014). All these benefits offered by VE in construction projects help in efficiently meeting the customers' requirement (Sharma & Kumar, 2017).

7.5.5 VE in design and procurement process and affordability of housing

From Table 7.10, it can be inferred that there is a significant positive correlation between VE in design and procurement process and affordability of housing. In other words, the use of VE may lead to affordable housing. On this basis the dual hypotheses of H5 and H10 (of section 5.7.1) should be accepted.

Affordable housing is an important concept and plays a crucial role in the real estate industry of many countries. Affordable housing is not just a vision that has to be achieved, but is a critical need of the hour. Houses are basic necessities, and making a home affordable is one of the solutions related to housing (Sharma & Belokar, 2012). The UAE government is taking major steps in the direction of making housing affordable. The VE here plays a crucial role by segregating the reasons behind the high costs in large-scale construction projects. VE helps in devising a proper plan that can be used to reduce the costs. VE is not only associated with the techniques of construction; however, it focuses right from the planning and designing phase. VE is one of the effective and systematic ways of reducing the overall costs that are involved in constructing the houses. VE also seeks to offer better project outcomes than those of the competitors and hence helps in achieving a competitive advantage (Sharma & Kumar, 2017).

7.6 Results of regression analysis

Cost of production

This section will give an account of the results of the regressions analysis. It helps in understanding the relationship between the independent and the dependent variables.

The R-square value is known as the coefficient of determination. This value shows how much variation in a dependent variable is explained by changes in the independent variables. According to Moore, Notz, & Flinger, (2013, p. 138), if the R- squared value is less than 0.3 then such value is considered as having none or very weak effect. If the R- squared value is between 0.3 and 0.5 then this value is considered as a weak or low effect. If the R-squared value is between 0.5 and 0.7 then, this value is considered to be of a Moderate effect. If R-squared value is greater 0.7 then, this value is generally considered to be a strong effect (Moore, Notz, & Fligner, 2013).

The R-square value of the data set shows the closeness of the data to the regression line. The R-square value of data is 0.574 as mentioned in the model summary, Table 7.11, which means that the regression model explains 57% of the variability of the data collected through respondents from its mean value. Thus, it can be stated that the model is a good fit of the data under observation. In other words, it can be said that VE in design and procurement process has moderate effect on the Cost of production.

The F-value shows whether the variance between the means of two populations is significantly different or not and the F-value of 64.6, according to Frost (2017), shows that there is a significant variance between the two variables. The beta coefficient gives an account of the impact of independent variables on the dependent variables. The value of the beta coefficient is 0.757, according to Bhalla (2015), means that the impact of VE in design and procurement process on the cost of production is significantly high and positive. It means that VE in design and procurement process reduces the cost of production. This again supports the acceptance of the dual H1 and H6 hypotheses of section 5.7.1. Similar findings about this connection were obtained by Smith and Freeman (2014). According to them, if the raw materials are procured at lower rates, the construction of the houses can be completed at the reduced rates and VE plays a significant role in the same (Smith & Freeman, 2014).

Table 7.11: VE in the design and procurement process and cost of production

Model summary				
Model	**R**	**R-square**	**Adjusted R-square**	**Std. error of the estimate**
1	.757[a]	.574	.565	.408

a. Predictors: (Constant), VE in design and procurement process

ANOVA[a]						
Model		**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
1	Regression	10.773	1	10.773	64.614	.000[b]
	Residual	8.003	101	.167		
	Total	18.776	102			

a. Dependent variable: Cost of production

b. Predictors: (Constant), VE in design and procurement process

Coefficients[a]						
Model		**Unstandardised coefficients**		**Standardised coefficients**	**T**	**Sig.**
		B	Std. error	Beta		
1	(Constant)	.487	.481		1.011	.317
	VE in design and procurement process	.870	.108	.757	8.038	.000

a. Dependent variable: Cost of production

Competitive advantage

The R-square value of the data set shows closeness of the data to the regression line. From Table 7.12, it can be seen that the R-square value of data is 0.636 which means that the regression model explains about 64% of the variability of the data collected through respondents from its mean value. Thus, it can be stated that the model is a good fit for the data under observation. In other words, it can be said that VE in design and procurement process has moderate effect on competitive advantage. The F-value of 83.7% shows that there is significant variance between the two variables. The value of the beta coefficient is 0.797 which means that the impact of VE in design and procurement process on competitive advantage is significantly high and positive. It means that

VE increases the competitive advantage and supports the acceptance of hypotheses H2 and H7 of section 5.7.1.

Table 7.12: VE in the design and procurement process and competitive advantage

Model summary				
Model	**R**	**R-square**	**Adjusted R-square**	**Std. error of the estimate**
1	.797[a]	.636	.628	.360

a. Predictors: (Constant), VE in design and procurement process

ANOVA[a]						
Model		**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
1	Regression	10.864	1	10.864	83.762	.000[b]
	Residual	6.226	101	.130		
	Total	17.090	102			

a. Dependent variable: Competitive advantage

b. Predictors: (Constant), VE in design and procurement process

Coefficients[a]						
Model		**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig.**
		B	Std. error	Beta		
1	(Constant)	.441	.424		1.040	.304
	VE in design and procurement process	.874	.095	.797	9.152	.000

a. Dependent variable: Competitive advantage

Conflict avoidance

The R-square value of the data set shows closeness of the data to the regression line. Table 7.13 shows that the R-square value of data is 0.682, which means that the regression model explains about 68% of the variability of the data collected through respondents from its mean value. Thus, it can be stated that the model is a good fit for the data under observation. In other words, it can be said that VE in design and VE in the procurement process has moderate effect on conflict avoidance. The F-value of 102.8 shows that there is significant variance between the two variables. The value of the beta coefficient is 0.826 which means that the impact of VE in design and

procurement process on conflict avoidance is significantly high and positive. It means that VE reduces the chances of conflicts between stakeholders (Sharma & Kumar, 2017). Overall the outcome supports the two hypotheses H3 and H8 of section 5.7.1.

Table 7.13: VE in the design and procurement process and conflict avoidance

Model summary					
Model	**R**	**R-square**	**Adjusted R-square**	**Std. error of the estimate**	
1	.826[a]	.682	.675	.40324	

a. Predictors: (Constant), VE in design and procurement process

ANOVA[a]							
Model		**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**	
1	Regression	16.716	1	16.716	102.800	.000[b]	
	Residual	7.805	101	.163			
	Total	24.521	102				

a. Dependent variable: Conflict avoidance

b. Predictors: (Constant), VE in design and procurement process

Coefficients[a]						
Model		**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constant)	-.606	.475		-1.275	.208
	VE in design and procurement process	1.084	.107	.826	10.139	.000

a. Dependent variable: Conflict avoidance

Achievement of needs

The R-square value of the data set shows closeness of the data to the regression line. Table 7.14 shows that the R-square value of data is 0.754 which means that the regression model explains about 75% of the variability of the data collected through respondents from its mean value. Thus, it can be stated that the model is a good fit for the data under observation. In other words, it can be

said that VE in design and VE in the procurement process has strong effect on achievement of needs. The F-value of 146.8 shows that there is a significant variance between the two variables. The value of the beta coefficient is 0.868, which means that the impact of VE in design and the procurement process on achievement of needs is significantly high and positive. VE helps in achievement of needs (Sharma & Kumar, 2017). This finding supports the H4 and H9 hypotheses of section 5.7.1.

Table 7.14: VE in the design and procurement process and achievement of needs

Model summary				
Model	**R**	**R-square**	**Adjusted R-square**	**Std. error of the estimate**
1	.868[a]	.754	.748	.31943

a. Predictors: (Constant), VE in design and procurement process

ANOVA[a]						
Model		**Sum of squares**	**Df**	**Mean square**	**F**	**Sig.**
1	Regression	14.981	1	14.981	146.823	.000[b]
	Residual	4.898	101	.102		
	Total	19.878	102			

a. Dependent variable: Achievement of needs
b. Predictors: (Constant), VE in design and procurement process

Coefficients[a]						
Model		**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig.**
		B	Std. error	Beta		
1	(Constant)	-.238	.376		-.633	.530
	VE in design and procurement process	1.026	.085	.868	12.117	.000

a. Dependent variable: Achievement of needs

Affordability of housing

The R-square value of the data set shows closeness of the data to the regression line. Table 7.15 indicates that the R-square value of data is 0.668, which means that the regression model explains about 67% of the variability of the data collected through respondents from its mean value. Thus, it can be stated that the model is a good fit for the data under observation. In other words, it can be

said that VE in design and VE in the procurement process has moderate effect on affordability of housing. The F-value of 94.49 shows that there is significant variance between the two variables. The value of the beta coefficient is 0.817 which means that the impact of VE in both the design and procurement process on affordability of housing is significantly high and positive. This supports hypotheses H5 and H10 of section 5.7.1. Indeed VE in the design and procurement process increases the affordability of housing products (Sharma & Belokar, 2012).

Table 7.15: VE in the design and procurement process and affordability of housing

Model summary				
Model	**R**	**R-square**	**Adjusted R-square**	**Std. error of the estimate**
1	.817[a]	.668	.661	.29122

a. Predictors: (Constant), VE in design and procurement process

ANOVA[a]						
Model		**Sum of squares**	**df**	**Mean square**	**F**	**Sig.**
1	Regression	8.014	1	8.014	94.496	.000[b]
	Residual	3.986	101	.085		
	Total	12.000	102			

a. Dependent variable: Affordability of housing

b. Predictors: (Constant), VE in design and procurement process

Coefficients[a]						
Model		**Unstandardised coefficients**		**Standardised coefficients**	**t**	**Sig.**
		B	Std. error	Beta		
1	(Constant)	1.063	.347		3.068	.004
	VE in design and procurement process	.760	.078	.817	9.721	.000

a. Dependent variable: Affordability of housing

7.7 Discussion of results

Table 7.16 represents the beta coefficient values for the five variables obtained through regression analysis. Regression analysis is used to establish the relationship between the independent and dependent variables (Statistics Solutions , 2018). The analysis has been done individually for all the variables to find their individual effect over the independent variables, i.e., 'VE in design and VE in the procurement process'. The beta coefficient values of the dependent variables have been arranged in the order of their direct impact on the independent variables. The independent variables proved to have a significant impact on all the dependent variables that were analysed. The joint 'VE in design and procurement process' has the highest impact on 'achievement of needs'. Similarly, the dependent variables like 'conflict avoidance' (0.826), 'affordability of housing' (0.817) and 'competitive advantage' (0.797) have a significant relationship with the two independent variables. Among all these dependent variables, 'VE in design and procurement process' has least impact on the 'cost of production' (0.757).

Table 7.16: Values of the beta coefficients of all dependent variables (descending order)

Variable	Beta coefficient	t	Significant value
Achievement of needs	0.868	12.117	0.000
Conflict avoidance	0.826	10.139	0.000
Affordability of housing	0.817	9.721	0.000
Competitive advantage	0.797	9.152	0.000
Cost of production	0.757	8.038	0.000

7.7.1 VE in design and procurement process and cost of production

From table 7.16, it can be seen that the significance value is less than 0.01, so VE in the design and procurement process has a significant impact on the cost of production. Thus, hypotheses H1 and H6 are accepted. The results of regression analysis indicate that if the principles of VE are applied, the cost of production in the construction projects can be reduced. Similar findings were obtained by Smith and Freeman (2014). According to them, if the raw materials are procured at lower rates, the construction of the houses can be completed at the reduced rates and VE plays a significant role in the same (Smith & Freeman, 2014). VE helps the engineers and designers in taking good procurement decisions for generating short lifecycles. VE and VM allow them to take

initiatives at the beginning for reducing the overall costs of a project (Sharma & Kumar, 2017). The studies have indicated that if the VE principles are applied during the initial stages of a construction project, it may help in the improvement of quality, reliability and marketability of the construction projects, keeping the costs to the minimum (Al-Yousefi, 2012). Thus, it can be said that the findings of the regression analysis are in line with the findings of the literature review.

7.7.2 VE in design and procurement process and competitive advantage

From table 7.16, it can be seen that significance value is less than 0.01, so VE in design and procurement process has a significant impact on the cost of production. Thus, hypotheses H2 and H7 are accepted. Similar results have been obtained through the study of literature as well. Sharma and Kumar (2017) conducted a study on VE and stated that it helps in the procurement of raw materials at the correct rates and time, which allows the architects to complete their project within restricted deadlines and budgets and hence gives them a competitive advantage over others (Sharma & Kumar, 2017). Another study indicates that VE provides a competitive advantage to companies mostly by reducing the costs involved in the process of procurement of raw materials (Tohidi, 2011). Heralova (2016) also stated that VE promotes direct communication among employees, which reduces the chances of conflicts and timely operations and recovery of raw materials . Thus, it can be said that the results of the literature review are comparable to the results of the regression analysis.

7.7.3 VE in design and procurement process and conflict avoidance

From table 7.16, it can be seen that significance value is less than 0.01, so VE in design and procurement process has a significant impact on the conflict avoidance. Thus, hypotheses H3 and H8 are accepted. Table 7.16 indicates that the impact of VE on conflict avoidance is significantly positive and the implementation of VE methods helps in the elimination of the chances of conflict. VE follows a function-oriented approach for studying the entire construction project and clarifies its objectives, goals, responsibilities and roles at the initial stages of the construction project. It helps in the elimination of chances of conflict during the entire project (Austin & Thomson, 1999). Therefore, the results of regression are in alignment with the results of the literature review.

7.7.4 VE in design and procurement process and achievement of needs

From the table 7.16, it can be seen that significance value is less than 0.01, so VE in design and procurement process has a significant impact on the achievement of needs. Thus, hypotheses H4 and H9 are accepted. As the regression table indicates, the impact of VE is highest on the achievement of needs. However, there are several researches which indicate that the impact of VE on achievement of needs is positive but, this research indicates that it is highest on achievement of needs in comparison to all the factors. Thus, it can be seen as a new finding in the field of VE. Table 7.16 represents the intensity of the impact of VE and VM on the procurement and design process on various factors. The value of beta coefficient obtained after the regression analysis shows that 'VE in design and procurement process' has the highest impact on 'achievement of needs'. Researchers have conducted their studies depicting the impact of VE on satisfying the customers or achieving their needs and demands. Sherwin (1968) is one such researcher who indicated that VE helps in procuring raw materials at lower rates and in an organised manner, which increases the affordability of housing.

Also, VE helps the designers to refine and structure the materials as per their quality and provide the latest designs to customers. Thus, the customers are satisfied as they get the best designs at highly affordable rates (Sherwin, 1968). However, the previous literatures do not present the results like this research. The present research shows that the maximum impact of VE and VM occurs on the achievement of needs. This can be seen as a new finding in the field of VE. This research shows that out of the five major factors affected by VE, the achievement of needs is impacted the most. The value of the beta coefficient (0.868) is highest in the case of achievement of needs. The major needs of the customers when they buy a new house include the affordability of house/s and high quality of materials (being) used in the construction. VE ensures the same by reducing the costs and improving the functionality and quality (Sharma & Kumar, 2017).

7.7.5 VE in design and procurement process and affordability of housing

From table 7.16, it can be seen that significance value is less than 0.01, so VE in design and procurement process has a significant impact on the affordability of housing. Thus, hypotheses H5 and H10 are accepted. The results of regression analysis suggest that the VE and VM impact the affordability of housing positively. Thus, if the VE principles are applied in construction projects,

then housing becomes affordable for people. The study of the literature done in the above section also provides similar results. It also suggests that VE helps in managing the costs effectively and thus, the construction projects are completed within budget, which makes the houses affordable for clients (Value Eng, 2016). The majority of the population in the nations across the world belong to the middle-income groups and hence, the basic expectation of them is to get a house in an affordable price range. VE helps in the segregation of the reasons responsible for the high costs of the housing projects and then, proper plans can be devised for reducing the extra costs through these reasons (Sharma & Belokar, 2012). Thus, it can be said that the results of regression analysis are in alignment with the results of the literature review.

Significance of the relationships obtained

The relationships established indicate that an increase in the factors affecting the VE and procurement process may help in improving the VE process and its status of implementation. For instance, if the achievement of needs is improved and enhanced, the VE process also improves. Thus, VE must be used in the procurement process in UAE in order to complete projects on time and make houses affordable for the common public of the nation. The relationships between these variables studied indicate that VE and VM are crucial for making the housing process affordable and meeting the needs of the people in the UAE and other parts of the world. If VE is used in construction projects, the costs of production can be reduced, conflicts can be avoided and customers can be satisfied. The relation between VE and these variables have direct impact on effectiveness of construction projects. In other words, if the implementation of VE increases, the effectiveness of construction projects also increase. VE makes all the processes of collection of raw materials, their procurement and their installation in housing projects effective and efficient (Smith & Freeman, 2014). Such results are reinforced by literature as well.

Researches related to increasing the efficiency of the projects with the help of VE are being conducted at great pace. Studies have suggested that most countries are trying to develop affordable housing in the best possible manner. The Government of the UK has also been trying to develop housing projects, which provide homes to the citizens within the affordable range, and has also been trying to promote ownership rather than providing housing facilities on a rental basis (LSE, 2015). Similar is the consideration of the Malaysian government. The government of UAE

is also focusing on developing houses in an affordable range, as the housing expense is the highest in the nation's GDP (Smith & Freeman, 2014). Thus, the major issue which is highlighted in the researches is related to affordability; however, this research indicates that there are also needs for people other than affordability, such as the presence of basic amenities, location of houses in proximity to common areas of the city, transport accessibility band, and other things. Thus, it can be suggested that the future researches can focus on the impact of VE on achievement of needs alone in order to get a better description.

7.8 Other analysis: VE implementation in the UAE

In addition to the question related to independent and dependent variables, the survey included several statements to determine the present status of the implementation of VE in the UAE housing sector, and knowledge management in VE in UAE's construction sector. Table 0.1 in Appendix III indicates the mean and standard deviation for each of these statements asked of the respondents. The mean score for all the statements is greater than four, implying that the respondents agreed or strongly agreed with them. Most of the respondents agreed or strongly agreed with the statement that there is a full implementation of VE in government housing projects (mean = 4.04, SD = 1.15). The study conducted by Ahmed (2016) also indicated that the VE approach is applied in housing projects in the UAE as it allows the managers to select the best design along with fulfilling the overall purpose (Ahmed, 2016). The respondents were asked to respond to the statement as to whether or not VE is fully implemented in privately sponsored projects in the UAE. Most of the respondents agreed or strongly agreed with the statement (mean = 4.12, SD = 0.97). The study conducted by Jeyakumar (2016) indicates that VE in the UAE provides tangible and intangible benefits to both private and government projects for houses. The responses indicate that VE is not a new concept for private and government-sponsored projects in the UAE.

- **Standard protocols in VE**

Further, the respondents were asked if standard protocols are followed while implementing VE in UAE housing projects. Most of the respondents agreed or strongly agreed with the statement (mean = 4.06, SD = 0.90). According to the study of Al Ahbabi (2014), protocols are an important part of the overall implementation of VE. The project protocols are established in the planning phase

so as to ensure the consistency of information. Standard protocols also maintain the efficiency of the VE process (Al Ahbabi, 2014).

- **Use of workshops and meetings**

The statement was also asked about the workshops and meetings involved in the implementation of VE. The respondents agreed or strongly agreed with the statement of inclusion of workshops and meetings in VE (mean = 4.33, SD = 0.65). The study by Constructing Excellence indicates that workshops and training are an important part of the VE approach: they are aimed at consolidating the designs along with conveying important information to the team involved in the VM implementation process (Constructing Excellence, 2012).

Further, the findings of the survey indicated that the respondents are not happy by being involved in the VE (mean = 4.04, SD = 1.06). It may be possible that the staff were not given the clear view of their roles and responsibilities. Also, there are chances that proper training and workshops are not carried out. The study conducted by Da Silva de Santis et al. (2016) indicated that VE is an approach that requires deep knowledge and training so that the approach can be implemented effectively. If the users of VE are not satisfied, then the approach will not be implemented effectively and this is one of the major issues.

- **Implementation of VE: time**

Further, a majority of the respondents also indicated that VE in construction takes a long time (mean = 4.04, SD = 1.07). This finding is again not consistent with the findings of the secondary research. The study conducted by Al-Yousefi (2012) indicates that if VE is implemented with the standards and protocol then it does not take much time. In addition, VE also helps in achieving sustainable construction (Al-Yousefi, 2012).

- **Implementation of VE: cost**

The survey questionnaire also included a question related to cost of implementing VE in the UAE construction industry. In this context, a majority of the respondents agreed or strongly agreed that the cost of implementing VE is high (mean = 3.96, SD = 1.18). The findings of Ilayaraja and Eqyaabal (2015), however, indicate that VE is one of the effective methodologies that help in

lowering the cost of construction without negatively affecting the quality. This result of the survey is not consistent with the previous reports in literature. This may be because the VE approach has not been implemented effectively.

- **Other responses**

In order to gain deep insights about VE in the construction industry of the UAE, the respondents were presented with other statements for rating. The respondents were asked whether the gains reaped from VE outweigh the time and cost commitments needed for carrying it out. Most of the respondents agreed or strongly agreed with the statement (mean = 4.16, SD = 0.81). This means that although the cost of VE implementation is high and it is a time-consuming process, the benefits derived from it still outweigh the cost. The study conducted by Ilayaraja & Eqyaabal (2015) similarly indicated that VE is extremely helpful in improving the quality, time and efficiency of projects.

The respondents were further asked whether or not the stakeholders fully understand the importance of VE in the construction industry. Most of the respondents stated that the stakeholders are still not fully aware of the importance of VE (mean = 4.16, SD = 0.87). In order to implement VE effectively in the construction industry, it is essential for all its stakeholders to understand it. According to Green (1990), it is important to understand VE. It should not be considered as a cost-cutting approach.

The participants in the study were then asked about the necessity of increasing the frequency of implementing VE in the UAE construction sector. A majority of the respondents feel that there is a need to increase the frequency of VE in the UAE construction sector (mean = 4.44, SD = 0.64). However, it is not the frequency of the VE application, but the standards and protocols followed during the implementation process that help in improving the quality and reducing the cost (Mostafaeipour, Mortazavi, & Sadra-Abarghouei, 2010).

The respondents were further asked to respond to a statement that there is a need to improve the implementation of VE in the UAE construction sector. The respondents agreed or strongly agreed with this statement (mean = 4.43, SD = 0.73). The respondents may not be satisfied with the VE implementation for several reasons, such as lack of training, lack of clear goals and objectives, etc.

According to the study conducted by Mitchell (2013) in order to implement VE in an organisation, it is essential to follow a standard approach. The lack of a standard approach may make the stakeholders dissatisfied. The majority of participants in the study were of the opinion that there is a need for proper guidelines to implement VE in the UAE construction sector (mean = 4.51, SD = 0.61). This particular finding is consistent with the findings of previous studies: Macedo Jr. and Dobrow (1979) indicated the importance of guidelines for VE implementation in both government and private-sector projects.

The respondents were also asked to respond to a statement that a government policy is needed for promoting the implementation of VE in all types of construction projects in the UAE, including housing construction. The majority of respondents strongly agreed or agreed with this particular statement (mean = 4.45 and 4.43, SD = 0.64 & 0.70). The respondents were also of the opinion that there is a need for proper monitoring of the VE programme and its performance (mean = 4.47, SD = 0.61). The study by Kliniotou and Gamage (2004) did show that monitoring VE performance contributes to the overall success of projects.

The majority of respondents to the survey agreed or strongly agreed that there is a need for the training of the staff so that they can implement VE effectively (mean = 4.49, SD = 0.58). According to the training guide of the US Department of Defense, training is one of the most important parts of VE as it helps in developing the capabilities of the personnel along with making them effective enough to follow the VE practices and approaches (Department of Defense, 2010). Thus, the findings of the survey are consistent literature in terms of the importance of training. The majority of the respondents were of the opinion that facilitators of VE teams should have the proper credentials (mean = 4.47, SD = 0.70).

7.9 Knowledge management in VE

A majority of the respondents agreed or strongly agreed with the statement that VE in UAE construction should be fully recorded in a standardised manner (mean = 4.52 & 4.54, SD = 0.58 & 0.70). Sharma & Belokar (2012) stated that standards should be maintained during the process of VE implementation. In addition, standards should be followed while capturing, gathering and storing the VE data. Thus when asked if the records of any VE exercise should remain a confidential project affair, the majority of the respondents agreed or strongly agreed with the

statement (mean = 4.04, SD = 1.22). The guideline given by Sharma and Belokar (2012) indicates that the implementation of VE is a confidential affair that should be restricted to only the important members involved in the project.

The participants were also asked whether or not a scale should be created for measuring the gains and pains of VE in the UAE. The majority of respondents strongly agreed or agreed with the statement that a scale should be created for measuring the gains and pains of VE in the UAE (mean = 4.46, SD = 0.65). This scale will help in determining the performance of VE in the UAE.

Lastly, the respondents were asked about the creation of a national data repository for feedback on VE. The majority of respondents believed that a national data repository should be established for feedback on VE (mean = 4.53, SD = 0.67). The findings of the primary and secondary research are consistent in terms of the creation of a data repository: Armbruster and Romary (2012) indicated in their study that repositories help in storing data and increasing knowledge.

7.10 Summary of Chapter 7

This chapter has analysed the quantitative data collected through a survey. The data were used to identify and establish the relationships between five dependent variables: achievement of needs, conflict avoidance, affordability of housing, competitive advantage and cost of production; and VE and VM in both design and procurement. The analysis of quantitative data indicates that all the five variables have a significantly positive relationship with VE and VM in the design and procurement of projects. The beta coefficient values of the five variables obtained through regression analysis are 0.868, 0.826, 0.817, 0.797 and 0.757 respectively, i.e. all are over 0.70, hence all these values indicate a significantly positive relationship between the five variables and VE and VM in both design and procurement. As per the values of the beta coefficient, the impact of VE and VM is highest on the achievement of the needs of customers. The minimum impact of VE among the selected variables is on cost of production. However, the five values are very close to each other in magnitude and they all are affected by the implementation of VE and VM practices during the design, procurement and construction of housing projects. The results of the quantitative data analysis are comparable to previously established findings that have been reported in the literature . These results will now be compared to the results of the qualitative study, as reported in chapter 8.

CHAPTER 8 – INTERVIEW: DATA, ANALYSIS, RESULTS AND DISCUSSION

8.1 Introduction to Chapter 8

Analyses of both quantitative and qualitative data are important for getting valid and reliable results in a research. The previous chapter gave an account of the analysis of the quantitative data, which were collected using the questionnaire survey. This chapter will analyse the qualitative data, which was collected from the respondents through interview, which was conducted on the basis of open-ended questions. The respondents had to give responses for the questions in a descriptive manner.

The interviews were conducted with directors, housing officers, and value engineers to get their opinions about the need for VE and VM in housing projects in the UAE. They were also asked questions regarding the provisions of VE in satisfying the needs of customers in UAE. This chapter discusses the outcomes of the interviews. In the end, the results obtained through interview analysis will be compared to the results of Chapter 7 as well as previously established findings from the literature.

Before starting the interviews, a brief introduction was given to the respondents as follows:

> *I am undertaking this interview to support my research work which aims to study the effective implementation of value engineering in the UAE housing construction sector. I identified that there is a lack of research work related to value engineering in the UAE construction sector and so, I decided to undertake this research so I can fill the gap to a certain extent by suggesting a new framework that can be implemented in the UAE construction sector. Value engineering has done wonders in many arenas and so I want to study it, and reproduce it in my research work so that the UAE construction sector take its advantage and further enhance its efficiency and effectiveness. The main aim of undertaking this interview is that I want to utilize the experience and knowledge of experts in the construction industry so that first-hand information related to value engineering can be collected. This interview will be recorded for my future reference so that I can use it at*

the time of analysis. This interview will take approximately 25-50 minutes. All the questions that will be asked will revolve around value engineering, its implementation, challenges, and usage in the construction industry, the current status of value engineering and its application in UAE construction projects, your personal experiences of how you have handled value engineering. Some questions are also related to the frequency of the use of VE in UAE and at which project stage it is implemented. So, this is an indication of the whole interview questions. I assure you that anonymity and confidentiality will be maintained in this interview and the processing of its information. So, before starting the interview, I would inquire if there are any doubts regarding the interview session?

8.2 Interviews

8.2.1 Interview questions

The interview instrument consisted of fourteen open-ended questions which were :

1. What are the major challenges in housing construction projects in the UAE?
2. How do you think value engineering and analysis is helping or hindering the delivery of housing projects in the UAE?
3. What are the major barriers associated with the implementation of value engineering and management?
4. What are the main benefits of VE in the UAE?
5. How frequently is VE used in the delivery of projects in the UAE?
6. How frequently is VE used in the delivery of housing projects in the UAE?
7. At which project phase is VE currently used in project delivery in the UAE?
8. At which project phase should VE be used in project delivery in the UAE?
9. How do you manage the challenges, if any, of value engineering and management?
10. How do you ensure the accuracy of data collected for value engineering and management?
11. How is the data used in VE preserved?
12. Please discuss some best principles and guidelines associated with value engineering and management for housing projects.
13. Please recommend some strategies that can help in improving the implementation of VM in UAE's housing projects.
14. Do you wish to comment freely on the use of VE in housing construction in the UAE?

These questions covered all the points which were required to be answered and important from the perspective of the research objectives.

8.2.2 Conduct of the interviews

The interviews were conducted face-to-face with the selected candidates. The experts for the interview were selected through convenience sampling and the ones who were available for the interview were chosen for it. The interviews were conducted and the responses were recorded in a tape recorder. The interviews were conducted within the working hours and offices of the respondents and each interview lasted for approximately 25 minutes. The shortest interview lasted 15 minutes while the longest took 45 minutes.

Ethics were maintained during the interviews. The interviewees had liberty to answer the questions in the desired length. Before taking the interviews of the respondents, all the required permissions were taken from the authorities so that no issues were raised due to lack of permissions. The participants in the interviews were also asked to sign the consent form which ensured that all the participants were prepared to answer the questions. The consent form used is attached as Appendix VII.

The identity of the respondents was kept anonymous and their responses were also kept secret; only the researcher knows the full identity of these respondents. Also, they were well informed about the purpose of the interview. The interviews were recorded in English language. The responses of the respondents have been discussed in the section below.

8.3 Information about interviewees

8.3.1 Sampling of the interviewees

The interviewees were obtained by the convenience sampling method and the interviewees were selected on the basis of their availability. 34 people were approached for interview and 30 agreed and were interviewed, giving a response rate for the interviews of 89%. The interviewees actively participated and responded to all the questions asked.

8.3.2 Background of the interviewees

Out of the 30 respondents, five were directors of construction companies in the UAE, 15 were housing officers and 10 were value engineers. The following Table 8.1 gives a breakdown of the basic information about the respondents.

Table 8.1: Anonymisation of interviewees

Interviewee no	Position	Years of experience	Profession	Anonymised identity	Interview conducted in?
1	Director	15	Architecture	XX1	English
2	Director	8	Architecture	XX2	English
3	Director	12	Architecture	XX3	English
4	Director	9	Value Engineer	XX4	English
5	Director	8	Value engineer	XX5	English
6	Value engineer	3	Value engineer	YY1	English
7	Value engineer	5	Value engineer	YY2	English
8	Value engineer	6	Value engineer	YY3	English
9	Value engineer	7	Value engineer	YY4	English
10	Value engineer	4	Value engineer	YY5	English
11	Value engineer	8	Value engineer	YY6	English
12	Value engineer	7	Value engineer	YY7	English
13	Value engineer	7	Value engineer	YY8	English
14	Value engineer	6	Value engineer	YY9	English
15	Value engineer	4	Value engineer	YY10	English
16	Housing officer	5	Housing officer	ZZ1	English
17	Housing officer	8	Housing officer	ZZ2	English
18	Housing officer	7	Housing officer	ZZ3	English
19	Housing officer	9	Housing officer	ZZ4	English
20	Housing officer	7	Housing officer	ZZ5	English
21	Housing officer	10	Housing officer	ZZ6	English
22	Housing officer	11	Housing officer	ZZ7	English
23	Housing officer	7	Housing officer	ZZ8	English
24	Housing officer	8	Housing officer	ZZ9	English
25	Housing officer	9	Housing officer	ZZ10	English
26	Housing officer	12	Housing officer	ZZ11	English
27	Housing officer	7	Housing officer	ZZ12	English
28	Housing officer	6	Housing officer	ZZ13	English
29	Housing officer	7	Housing officer	ZZ14	English
30	Housing officer	7	Housing officer	ZZ15	English

According to Table 8.1, five of the interviewees (16.6 %) are directors, 10 (33.3 %) are value engineers while 15 (50%) are housing officers. The average duration of their experience is six to seven years.

8.4 Overview of the data

The qualitative data analysis was conducted with the help of interviews of the respondents mentioned above. The identities of the participants were kept anonymous on their request. Anonymised identities are used as reflected in Table 8.1.

The data collected from all the interviews was tape-recorded. For analysing the interview responses, first of all an interview transcript was prepared based on the recorded responses. An interview transcript has also been attached in Appendix IV. The following section shows the summarised form of the interview results.

8.4.1 Data analysis technique

There are two major techniques that are useful for qualitative data analysis, namely content analysis and thematic analysis. Content analysis is used as a technique to analyse texts and it is used for analysing large amounts of textual information for determining the patterns and trends of words or phrases. Thematic analysis, on the other hand, is used as an approach for analysing, identifying and recognising patterns within data and thus, it can be used as a valid technique for analysing qualitative data, as it analyses the repetition of words (Sekaran & Bougie, 2016).

In this study, content analysis has been used to analyse the qualitative content of the interviews using the patterns and trends of the words used by the interviewees. No specific software was used for the analysis of the interview responses. Content analysis was performed based on steps discussed by Erlingsson & Brysiewicz (2017). By recording the communication which was conducted between the researcher and the interviewees, the interview transcript was developed and used for analysing the communication. Figure 8.1 shows the steps followed for analysis of qualitative data.

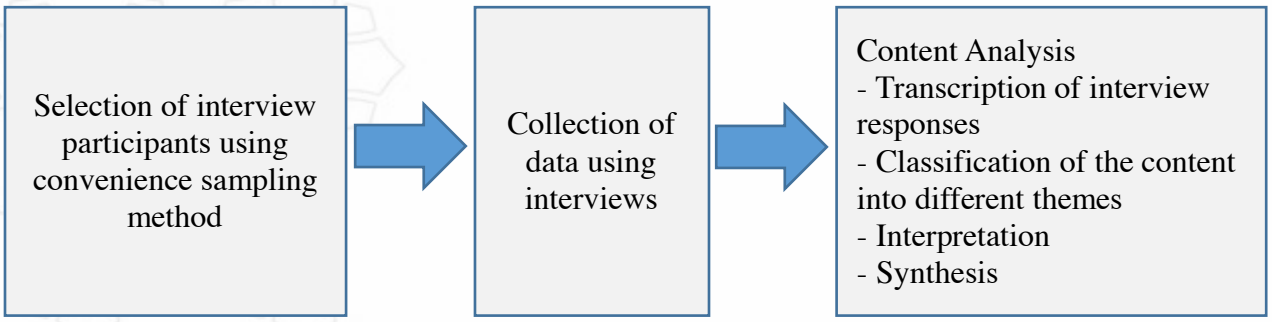

Figure 8.1: Steps in Qualitative Data Analysis

Content analysis

There are two types of content analysis, which are conceptual analysis and relational analysis (Columbia University, 2019). For this research purpose, conceptual content analysis has been utilised for analysing the interviews. The interview responses were analysed on the basis of the research questions and selecting the explicit and implicit terms existing in all the responses. The coding of explicit terms had been easier but for implicit terms, contextual translation rules were utilised. This technique has been taken into consideration for interview purpose because interview questions have been prepared on the basis of variables and research questions.

The content analysis was performed based on a number of steps as suggested by Erlingsson & Brysiewicz (2017). First, the data was prepared and the interview was transcribed. The theme of the analysis was identified by classifying the content into different themes. These themes are challenges of housing, increasing the quality of housing through VE, rate of implementation of VE in UAE, primary requirement for VE in the UAE, frequency of implementation of VE in the UAE housing and construction industry, phase of construction which requires VE to be implemented, implementation of VE in construction phase, major challenges before a full-fledged implementation of VE in the construction industry, collection of data for implementing VE, preservation of collected data for VE, VE application during planning phases, and application of VE in the construction phase.

The respondents were also divided into different groups and were given codes to keep their identities anonymous. After classification, the major responses of the respondents related to each question were analysed and the findings were presented accordingly. The interviews have been

analysed by the utilisation of conceptual content analysis and coding of implicit and explicit responses were taken into consideration for analysing the content.

8.5 Outcomes of the data analysis

The data analysis yielded results on various aspects of the study. The outcomes are presented in the following subsections.

8.5.1 Challenges of housing

The respondents highlighted that the major challenges in the housing construction industry of the UAE were related to the high costs of production and procurement challenges. According to XX3, '*the increase in costs of the construction projects is due to the increment in the variety of materials which can be used for making the buildings in UAE. The increase in the prices of these materials presents the challenge of high costs*'. A few other interviewees indicated that the development of corporate and large-scale residential buildings has to follow a number of regulations, which further adds to the increased costs, as there is a need for the incorporation of expensive materials to fulfil these.

Another major challenge highlighted by the interviewees included high procurement cost and time. YY7 said that, "*the increase in the procurement costs adds to the overall value of the buildings, which makes them less affordable for the people*". The literature review also states that procurement and high costs of production are the major factors posing challenges for construction projects in the UAE (McGinnis, 2005).

These findings of the interview are comparable to those of the survey as well, where it was found that the major factors which affect the housing or construction projects in the UAE included budget allocation, government influence and policies, availability of infrastructure, demand and supply, location and other similar things.

8.5.2 Increasing the quality of housing through VE

VE is increasing the quality of construction projects in the UAE as it is doing in other parts of the world. The respondents supported this view. Particularly, interviewee YY3 highlighted the point

that, '*the value engineering helps in finding the alternatives for the materials which can be used for carrying out the construction projects, which improves the quality of construction as well as reduces the costs of construction'*. This statement of the interviewee is also supported by literature as opined by (Al-Yousefi, 2012). The survey results have highlighted similar results. They have showed that VE helps in improving the procurement process, improving competitive advantage, avoiding conflicts, increasing affordability of housing and the achieving of needs.

8.5.3 Rate of implementation of VE in the UAE

The respondents in the survey highlighted that VE is not implemented in a full-fledged manner in the UAE, as construction staff are often not given effective training on VE. ZZ7 stated that, "*there are not sufficient workshops and sessions organised in the UAE regarding the implementation of value engineering and thus, VE is not implemented in the country in a fully effective manner. This field requires in-depth knowledge and needs special training workshops to be organised at regular intervals to train the construction employees in an effective manner*". This is comparable to the findings in literature suggesting that VE and VM need excessive training and in-depth knowledge before their implementation (Constructing Excellence, 2012). The results of the survey are also comparable to the same.

8.5.4 Primary requirement for VE in the UAE

According to the respondents in the survey, the first requirement of VE in the UAE is to increase the affordability of housing in the nation. The use of diverse construction materials and the high costs of these construction materials have added to the value of homes in the nation. VE will make sure that the raw materials are procured at effective prices to make housing affordable. Another point that was highlighted in the interview was the use of VE and VM in improving the quality, price and functionality of houses, which in turn will ensure maximum customer satisfaction. These opinions of the interviewees can be compared to the findings of the literature review as well, i.e. researchers also agree that VE in procurement and design helps in making houses affordable (Sharma & Belokar, 2012) and ensure customer satisfaction (Sharma & Kumar, 2017).

8.5.5 Frequency of implementation of VE in the UAE housing and construction industry

According to the interview respondents, the frequency of implementation of VE in the construction sector is less for now and, it needs to be implemented more vigorously. ZZ4 said, "*of course, there is need to implement VE in UAE after knowing the excessive benefits it presents for the people. For increasing its implementation, it is necessary that the training sessions for it are organised well and government policies and regulations favour the same*". Mostafaeipour, Mortazavi, and Sadra-Abarghouei (2010) also indicated the same view in their study where they also noted that if VE implementation needs to be improved in any nation, changes in government policies should to be made (Mostafaeipour, Mortazavi, & Sadra-Abarghouei, 2010). According to respondent YY3, "*when it comes to the implementation of VE in the construction sector, the statistics are even lesser*". This statement highlights the actual position of the implementation of VE in the design of housing projects in the UAE.

8.5.6 Phase of construction requiring VE to be implemented

According to the respondents, VE is required to be implemented in the planning phase. Projects may be planned as per the VE requirements but, when it comes to implementation, these projects are not in complete compliance with VE. According to interviewee ZZ9, 'value engineering is far from actual implementation in the UAE. The commercial projects are planned using principles of value engineering but, the implementation of value engineering in housing projects is limited'. These results of the interview can be viewed as comparable to those in the literature as well, because according to a recent study conducted by Ahmed in 2016, the UAE is also implementing VE and VM in the housing industry (Ahmed H. T., 2016). However, the other survey responses have highlighted that its pace is slow and it is also seen that the implementation of VE increases the time required for construction activities.

8.5.7 Implementation of VE in construction phase

According to the interview respondents, the implementation of VE must be done in the construction phase also. According to ZZ1,"*the implementation of VE during these phases allow the constructors to get the latest information related to the same as well as allowing them to procure the materials at the lowest possible costs"*. This statement highlights the importance of

VE and VM in the procurement of the raw materials required to carry out the construction. There is a variety of raw materials present in the market and VE allows the constructors and the engineers to understand the most suitable requirements and choose the best to ensure maximum customer satisfaction. This statement by ZZ1 corroborates Sherwin who claimed that VE must be applied in the construction phase while procuring raw materials so that the designers can refine their concepts of the designs and choose the most suitable designs and materials based on the knowledge of the latest facts (Sherwin, 1968).

8.5.8 Major challenges before a fully-fledged implementation of VE in the construction industry

XX2 responded by saying that, '*the major challenges faced by us while implementing the VE in all the construction processes and phases is the lack of knowledge regarding value engineering in our teams*'. The workers are not trained and lack the skills required for implementing VE. The managers have to manage these issues and make sure that the designers are aware of the benefits of VE. For this, the managers must focus on organising meetings and workshops for the designers. In meetings, they discuss the benefits of VE for housing construction projects and the workshops are organised to train the employees in the concepts of VE so as to gain the benefits of VE and VM practices. This is also supported by the literature which shows that the workshops and trainings related to VE will help in its smooth implementation and prove to be a saviour for the housing construction industry in the UAE (Constructing Excellence, 2012). Also, managers should focus on communication of its benefits to their team so that they can adopt them.

8.5.9 Collection of data for implementing VE

As mentioned by the interviewees, the data for VE is collected through long and descriptive research. The collected data or alternatives are tested through matrix analysis to check which data is most suited for the targeted project and which alternatives will suit the requirements of the project in a manner that will ensure maximum customer satisfaction. According to ZZ11, '*we choose the alternative which is the best blend of schedule, cost and performance*'. The project, once decided to be best suited, is developed using the cost estimates, sketches, technical work and data validation. This position is comparable to the study of the literature performed above (Othman, 2008; Rane & Attarde, 2016). There also, it has been proven that accurate methods must

be used to determine the best VE practices to be used in order to ensure maximum customer satisfaction with high quality performance and low input costs.

8.5.10 Preservation of collected data for VE

The data for VE is preserved through both manual and computerised records. These records allow the designers to keep a track of the best practices of VE. The computerised records allow the designers to check the VE practices which yield the best for housing projects. The data of VE can also be preserved throughout the VE life cycle where the data are stored for future recommendation after evaluation of its key benefits.

8.5.11 VE application during the planning phases

First of all, it must be ensured that the VE principles are used before the commencement of the housing project for maximising its results. The implementation of VE and VM during the planning phases proves to be most effective, as at that stage only, the key decisions regarding requirements and procurement are taken. The project value must be kept at the top, even above the cost. The budget must not compromise with the quality of the project. It must be ensured that the construction of the project goes hand in hand with the determined plans. The planning must not be different from the implementation. The risks of the planning phase must be identified at the beginning and precautions must be taken from the initial stage. The buffer or alternative plans regarding the materials, cost and other such things must already be kept in mind, as they keep on changing, and every time, there must be a solution available which promises the best possible outcomes. A few other principles suggested by the interviewees included completing the projects before the time of delivery, using a subcontractor at the initial stages and other such things (Atabay & Galipogullari, 2013).

8.5.12 Application of VE in the construction phase

The application of VE in the construction phase can be improved by a number of methods, e.g. using a subcontractor at the beginning of the project, and obtaining all the required construction permits before the commencement of the project. ZZ12 said that "*the units at the worksite must be already prepared before the project starts so that it saves the initial time*". For improving the quality relations, one of the interviewees suggested that the project production or drawing and the

repair method for the repair and reconstruction must already be determined within the guarantee period and the tolerance values must be predetermined so that the project completes within the determined time ranges only. These results are comparable to those of (Atabay & Galipogullari, 2013).

8.6 Final thoughts in context of VE application in the construction phase

In the researcher's opinion, VE is one of the latest methodologies introduced in the housing construction sector in the UAE. This methodology should be well learnt and must be taught to the designers properly. Training is very much required for the effective implementation of this technique as it is relatively new to UAE housing delivery and many of their construction designers are not aware of the full skill set needed to implement it. The respondents in the survey have highlighted the usage of this technique as it reduces the costs, opens the avenue of alternative solutions and improves the quality of projects, which definitely improves the customer satisfaction as suggested by many researchers in the literature review (Ahmed H. T., 2016; Sharma & Belokar, 2012).

8.7 Summary of Chapter 8

The interview included many questions regarding VE in the UAE. The responses of the respondents have helped in gaining a clear picture of VE in the context of the UAE along with giving deep insights into the views of people regarding VE. The findings of the interviews supported the finding of survey analysis of chapter 7 which indicated that there is significant positive correlation between 'VE in design and VE in the procurement process' and competitive advantage. Further, it also supported the survey finding that there is a significant positive correlation between VE in design and procurement process and achievement of the needs of all the stakeholders involved in the process. It has also been found that VE may reduce conflicts during construction project execution. In addition, the interview finding also supports the survey finding that there is significant positive correlation between VE in design and procurement process and affordability of housing. In other words, it can be said that VE may make housing more affordable (Al-Yousefi, 2012). However, the interview responses indicated that there are many aspects of VE implementation in the construction industry of the UAE that need to be reviewed and improved.

The findings of the interview analysis also indicated that the time and cost involved in implementing the VE approach are high.

There is a need to reduce the time and cost involved in VE so as to completely utilize this approach in the construction industry of the UAE. The interview respondents were of the opinion that VE implementation has not gained full acceptance in the UAE because of the lack of knowledge regarding it. The workers, engineers and managers are not trained and lack the skills required for implementing VE. The respondents also highlighted that it is important to implement VE at the planning and construction phases in order to realize its full potentials.

To overcome the challenges associated with the VE implementation in the UAE construction industry a new framework is proposed in the next chapter. This new framework will facilitate the implementation of VE in UAE (housing) construction. The most important change to practice that will be highlighted in the new framework will be reflected in the planning and implementation stages of VE. The new framework will aim to make necessary changes in the whole process of VE on the basis of how it is being used till now. The main benefit of this will be reflected in the reduced time and elimination of cost overruns in construction projects. All the five variables that have been discussed above will be utilized in the new VE framework in a strategic manner. The desired outcome of this new framework is to offer maximum satisfaction to its customers and other stakeholders by enhancing the efficiency of construction projects.

CHAPTER 9 NEW FRAMEWORK TO IMPLEMENT VE IN UAE HOUSING PROVISION

9.1 Introduction to Chapter 9

This chapter will analyse the findings of this research and will develop a framework on this basis. The framework will provide basic guidelines and instructions for value engineers and contractors regarding the implementation of VE measures. The framework has been developed based on the measures that an organisation must take in the planning and implementation stages. The implementation of these measures will allow contractors and value engineers to deliver the most efficient and effective housing construction projects.

9.2 Summary of the research findings

The research was conducted in order to determine the application of VE and VM in housing construction projects in the UAE. VE and VM play a significant role in making construction projects more viable and affordable and also in managing the risks in the most effective manner. This research has studied the impact or significance of the relationship between VE and VM and five variables, which are achievement of needs, conflict avoidance, affordability of housing, competitive advantage and cost of production. These are the five variables that impact the construction of housing projects significantly. The research findings indicate that all five variables have a significant positive relationship with VE and VM in the design and procurement processes. If the application and implementation of VE increases in the construction projects in the UAE, all these five impacted factors can be achieved more successfully and maximum customer satisfaction can be ensured (Sharma & Kumar, 2017).

According to the literature review, the major issue of concern in relation to construction designers and engineers in the UAE is their inability to meet all aspects of customer satisfaction. A major concern for customers is that construction projects take more time than promised before accommodation is actually provided. Not only does the time interval exceed specified deadlines but costs also increase compared to specified values (Othman, 2008). VE is not implemented effectively in the UAE and, according to Atout (2016), the culture of the country is one of the major contributing factors in reducing the rate of effective implementation of VE. People living in

the UAE prefer their houses to be constructed according to traditional and cultural orientations. VE, however, is based on the concept of developing houses based on new technologies (Atout, 2016). However, the country needs to embrace measures regarding the development and implementation of a VE framework in order to reduce project costs, procure cost-effective materials of high quality and reduce maintenance costs.

The current VE model followed by constructors and engineers in the UAE can be separated into three major phases: the pre-workshop study phase, the workshop study phase, and the post-workshop study phase. The pre-workshop study phase includes pre-study activities; the workshop study phase encompasses the information phase, function analysis, the creative phase, evaluation, development, and presentation; and the post-workshop study phase includes implementation, follow-up activities, and the preparation of written reports, which are sent to all members of the team so that the strategy can be effectively implemented by everyone. All these phases have been discussed in detail (Male & Steven, 1998) and are highlighted in the literature review in Section 2.6. However, the implementation of VE in the UAE has challenges, such as the development of a team of Value Engineers and Value Managers with the required skills, convincing people to use VE and VM in housing projects, and convincing contractors to implement these value enhancement principles in projects.

With these considerations in mind, a VE framework is proposed that can address the current constraints in the VE process in the UAE by introducing changes for improvement. It is time for the UAE to begin implementing VE in the construction of (public) housing projects. All five variables investigated in the research and identified above need to be successfully implemented in a new VE framework to improve the quality of housing construction projects in a bid to satisfy the customers in the country by resolving their issues of concern (Ahmed & Raheem, 2016).

9.3 Proposed VE framework to improve effectiveness of provision of housing construction projects in the UAE

The framework is introduced by identifying the factors for improvement.

9.3.1 Identification of the improvement factors

According to this study, VE and VM principles need to be integrated into both the project planning and implementation stages. The planning stage is the main phase in housing construction projects as it includes all design strategies for the projects; it holds a place in creativity and innovation, and the designed plan is finally implemented (Behncke, Maisenbachera, & Maurer, 2014).

9.3.2 Project Improvements during the planning stage

Figure 9.1 shows the newly designed model, which consists of six main items:

Item 1: Determination of information related to the five variables used in the research affecting VE, using efficient tools

In Section 7.4, it has been highlighted that VE influences five major factors in housing construction projects: achievement of needs, conflict avoidance, affordability of housing, competitive advantage and cost of production. It helps in the integration of all the requirements of the projects that are essential to complete the project within determined deadlines and costs. The implementation of analysis tools could also be beneficial in the identification of external and internal factors that influence these variables. It could enable the designers to include systemic thinking and diagnosis of factors that could influence the variables as well as strategic plan that could be developed for project success (Behncke, Maisenbachera, & Maurer, 2014).

Item 2: Integration of the VE activities in all project stages to reduce procurement costs and increase affordability

The VE principles need to be incorporated at all project stages as determined through the review of the literature in Chapters 2 and 3. Non-implementation at any particular stage may lead to the failure of the project. Therefore, to synchronise all activities within the project, the VE needs to be implemented effectively at all stages. In addition, all tasks under all stages must be properly scheduled in terms of project time as well as budget. Accordingly, Figure 9.1 shows the proposed VE framework.

Item 3: Organisation of VE workshops for engineers in the emirates at the end of initial design stage

Workshops should be conducted for VE from time to time and such workshops should enable contractors to understand the major challenges being faced in the planning and implementation stages. As mentioned in the literature review in Section 2.5, it has been recommended that the organisation organizing such workshops before the initiation of a new project should perform their projects in an effective manner. However, only large companies utilize VE; small construction companies or projects do not consider them too necessary. However companies must organise VE workshops effectively and regularly to ensure that engineers, constructors and company managers could understand the importance of VE and VM in especially housing projects.

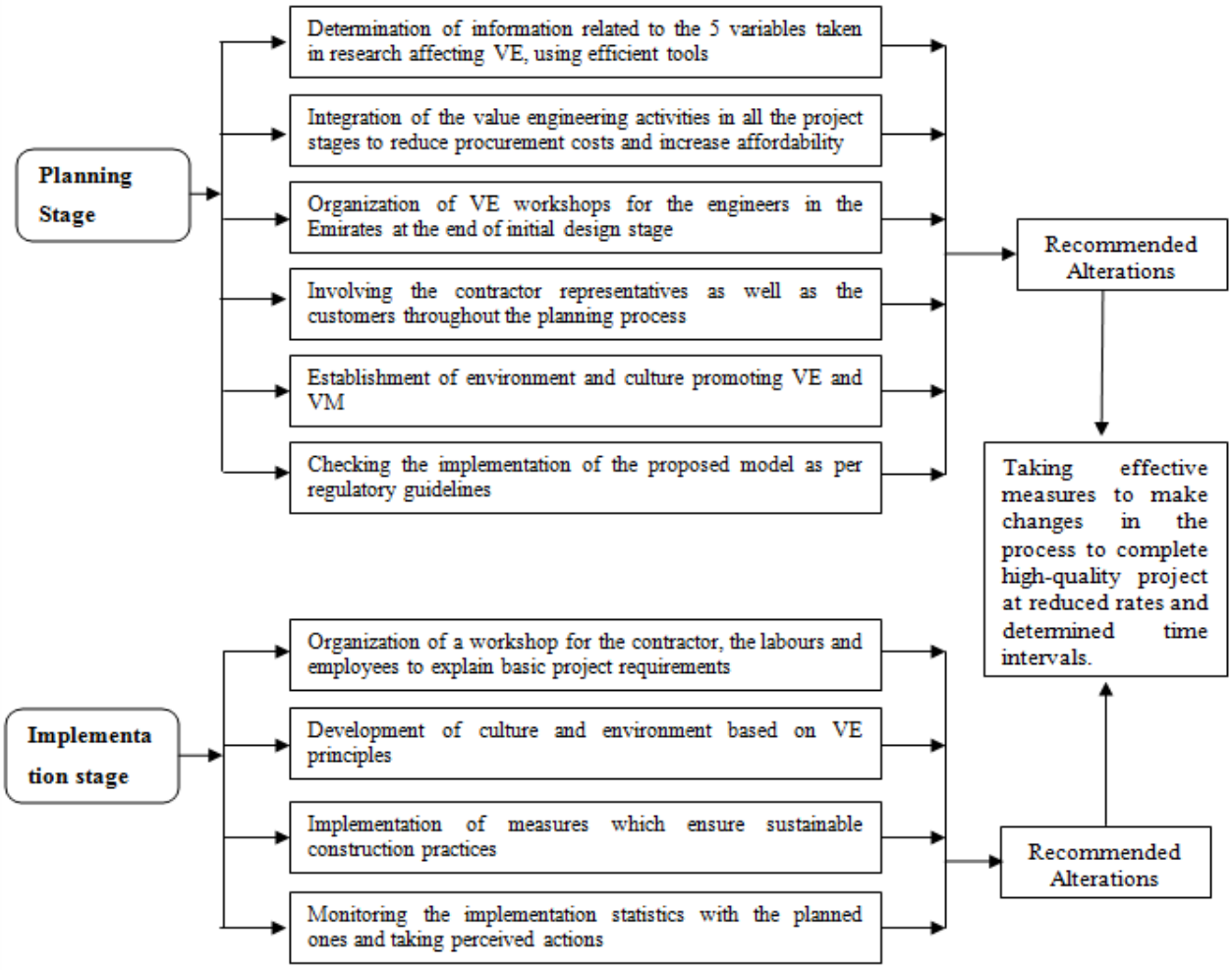

Figure 9.1: Proposed VE framework

Table 9.1 provides additional information that explains the proposed framework.

Table 9.1: Measures taken and parties responsible

Measure to be taken	Time required	Responsible people
Determination of information related to the five variables	3–6 months	Researchers in the housing industry; contractors; value engineers and value managers; management of the construction industries
Integration of VE activities in all project stages	Over the course of the project	Value engineers and contractors
Organisation of three workshops	Within first three weeks In following three months	Management of construction companies and value managers
Involving contractors' representatives and customers	Throughout the planning process	Management of construction companies and value managers
Establishment of environment and culture promoting VE and VM	Throughout the planning process	Management of construction companies and value managers
Checking implementation of the proposed model	Every six months	Constructors and auditors; management of construction companies and value managers
Organisation of workshop for contractor, workers and employees	Before the project begins	Management of construction companies and value managers
Development of culture and environment based on VE principles	Throughout the construction process	Management of construction companies and value managers
Implementation of measures that ensure sustainable construction practices	Throughout the construction process	Value engineers, contractors and management of the company
Monitoring implementation statistics with planned statistics	Every three months	Management of construction companies and value managers

Item 4: Involving the contractors' representatives and customers throughout the planning process

The planning process should include end users to make them aware of the available facilities. The contractors should communicate with the clients regarding project inclusions and ensure satisfaction of the clients. The value engineers should keep contractors in the loop regarding all the details of the project (Rad & Yamini, 2016). The practical aspects of construction should be

executed as per the planning of the VE but contractors work in the field for completion of the projects, that is why, involvement of contractors' representatives and customers is essential in planning process.

Item 5: Establishment of environment and culture promoting VE and VM

The VE principles need to be clearly communicated with all employees working on the project (Value World, 1996). Therefore, there needs to be a culture of VE in an organisation. All designers, employees, contractors and facilitators must be aware of the benefits of the VE principles and all information must be exchanged with the authorities as well as the clients.

Item 6: Checking the implementation of the proposed model as per regulatory guidelines

The guidelines pertaining to the construction of houses in the construction industry continue to change (National Institute of Building Sciences, 2018). Therefore, Value Engineers need to ensure that all measures taken are in accordance with regulations. The major concern for construction projects is that they must abide by all sustainable development guidelines issued by the UAE government. The country has paid significant attention to sustainable development. The required sustainable certificates must be obtained from the authorities, as a failure to do so may result in several restrictions being placed on the completion of the project within the determined budget and time.

9.4 Project improvement during the implementation stage

The implementation phase includes the design, construction, handover and operations phases of a construction project.

Item 1: Organisation of a workshop for the contractor, workers and employees to explain the basic project requirements

A further workshop must be organised for the contractors, employees, project managers and value engineers before construction begins. This will be the fourth workshop in the sequence. The workshop will help to review the designed or planned aspects of the project and determine the implementation of the plans during the construction phase. This workshop will determine the technical and commercial success of the project.

Item 2: Development of culture and environment based on VE principles

As mentioned above, the incorporation of VE at every stage is necessary and can occur only when a culture of VE is created within an organisation. All employees and workers need to be made aware of what is expected of them and how they can achieve what is required.

Item 3: Implementation of measures that ensure sustainable construction practices

Sustainability guidelines such as Estidama (Alobaidi, Mohammed, & Baqutayan, 2016) apply to all construction projects in the UAE to ensure the materials and practices used during construction of the project do not undermine sustainability. The goal of Estidama is to preserve and enrich physical and cultural identity of Abu Dhabi and to improve the quality of life for residents under the four pillars of sustainability i.e. environment, economic, social and culture. This is a major responsibility on the contractor in terms of measures taken to ensure the sustainability of the project. If the contractor fails to implement or attain the sustainability measures, this can result in heavy fines or can pose other significant risks to stakeholders.

Item 4: Monitoring the implementation statistics with those planned and taking perceived action

This is one of the most important steps in the implementation phase. The construction of the project must be cross-checked with the planned guidelines. This needs to be carried out at fixed intervals of three months (National Institute of Building Sciences, 2018). It will help to measure the discrepancies between the perceived and actual accomplishments of the project. It will also ensure that all risks are properly handled, as well as indicating the pitfalls that need to be avoided (Alkhereibi, 2017).

9.5 Link between the conceptual and proposed frameworks

The conceptual framework proposed in Chapter 5 dealt primarily with the intended collection of data with the help of surveys and interviews from experts in the housing industry in the UAE. It included the variables used in the primary study which was conducted using the survey. The five variables in the conceptual framework need to be included in UAE's VE procedures to ensure the pertinent issues are addressed specifically. The conceptual framework was intended to gain responses from the participants regarding the application of VE in the UAE. On the basis of the

results of the data analysis, the framework for VE (Figure 9.1) was proposed. The findings of the results mentioned in Section 7.4 indicate that there is a requirement to involve the people working in construction projects in the process by organizing the workshops for them so that they can understand the concepts of VE and VM and implement these in the construction process. Therefore, the proposed framework focuses on the organisation of these workshops so that the contractors and engineers can be trained in the appropriate skills. The conceptual framework in this research and the proposed framework for VE implementation in the UAE are thus interconnected.

9.6 Validation of the proposed framework

The framework shown in Figure 9.1 was tested using experts involved in or familiar with (public) housing provision in the UAE. They were provided with the framework and asked to complete a questionnaire. The validators were asked about their opinions regarding various aspects of the framework such as the use of effective tools to determine the factors influencing VE, the implementation of VE at all stages of a project, the organisation of workshops, the involvement of contractors and clients, the development of a VE culture and environment, abiding by sustainability guidelines, and monitoring and evaluation processes. The questionnaire (instrument) used in this regard is provided in Appendix V.

The questionnaire was provided to the following 40 Emirati respondents to validate the proposed framework. Table 9.2 provides a breakdown of the validators, all Emiratis, who comprised:

- Value engineers – 10
- Project managers – 10
- Clients – 10
- Contractors – 10

The respondents were selected members of the population and they were asked to mark their answers according to a Likert scale. All 40 participants were involved in the original questionnaire survey and, were approached by means of convenience sampling. Table 9.2 provides some information about them.

Table 9.2: Anonymisation of Emirati respondents

Validator no.	Type of organisation	Years of experience	Codes	Completed the questionnaire?
1	Value engineer	15	AA1	Yes
2	Value engineer	8	AA2	Yes
3	Value engineer	9	AA3	Yes
4	Value engineer	11	AA4	Yes
5	Value engineer	13	AA5	Yes
6	Value engineer	14	AA6	Yes
7	Value engineer	12	AA7	Yes
8	Value engineer	7	AA8	Yes
9	Value engineer	7	AA9	Yes
10	Value engineer	9	AA10	Yes
11	Project manager	5	BB1	Yes
12	Project manager	8	BB2	Yes
13	Project manager	10	BB3	Yes
14	Project manager	9	BB4	Yes
15	Project manager	11	BB5	Yes
16	Project manager	7	BB6	Yes
17	Project manager	8	BB7	Yes
18	Project manager	9	BB8	Yes
19	Project manager	11	BB9	Yes
20	Project manager	12	BB10	Yes
21	Client	13	CC1	Yes
22	Client	10	CC2	Yes
23	Client	12	CC3	Yes
24	Client	11	CC4	Yes
25	Client	10	CC5	Yes
26	Client	8	CC6	Yes
27	Client	7	CC7	Yes
28	Client	7	CC8	Yes
29	Client	7	CC9	Yes
30	Client	9	CC10	Yes
31	Contractor	11	DD1	Yes
32	Contractor	12	DD2	Yes
33	Contractor	11	DD3	Yes
34	Contractor	12	DD4	Yes
35	Contractor	12	DD5	Yes
36	Contractor	12	DD6	Yes
37	Contractor	13	DD7	Yes
38	Contractor	14	DD8	Yes
39	Contractor	15	DD9	Yes
40	Contractor	15	DD10	Yes

The total number of potential respondents approached was 45. Of these, 40 responded to the survey. Therefore, the response rate was 95%. The collected data were analysed using descriptive statistics, i.e. the percentage of the responses was calculated using Microsoft Excel. The responses reported by the majority of respondents were taken into account and the framework was refined accordingly. On the basis of the survey responses, the framework was validated and further improved.

9.7 Results of the validation

9.7.1 Planning stage

Item 1 - Use of effective tools

Figure 9.2 shows that this item had significant support from the respondents and 90% respondents were in favour of the use of effective tools to determine the factors that can influence the variables associated with VE. Of the 40 respondents, only four disagreed with the statement. Influence on the proposed framework: a few respondents asked for the techniques that can be used for this purpose, which have been addressed in the improved framework.

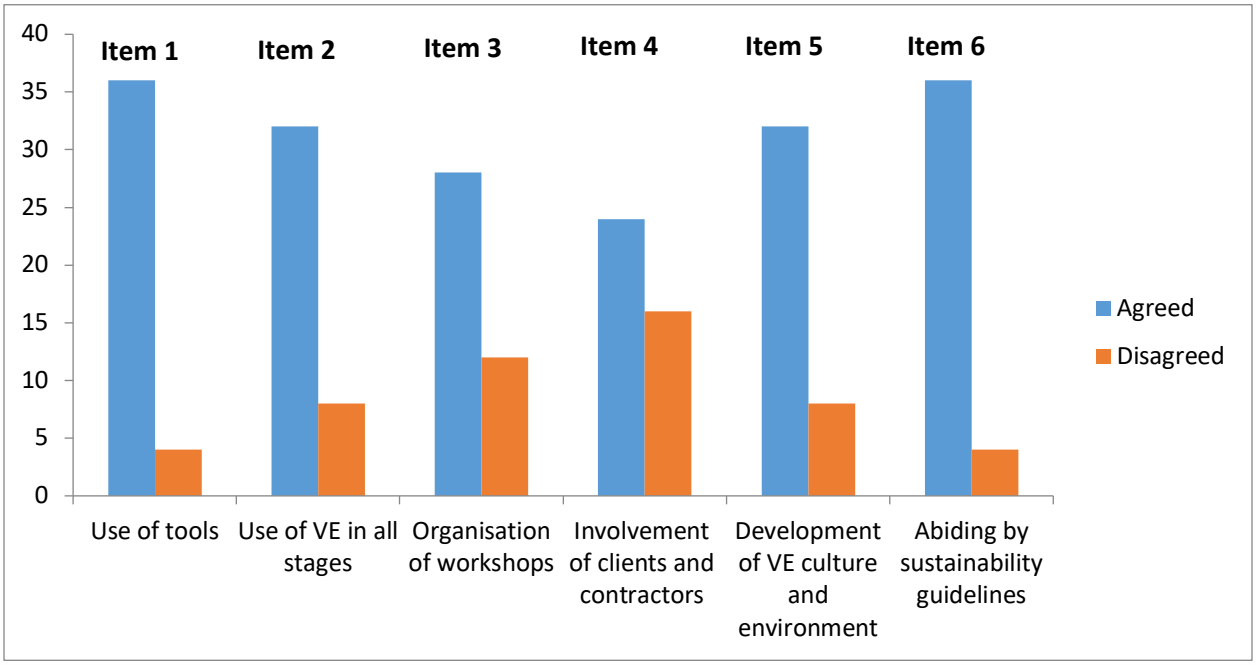

Figure 9.2: Responses to Item 1 to 6

Item 2 - VE in all stages of a project.

Item 2 on the validation questionnaire related to the use of VE in all stages of a project. Eighty per cent of respondents agreed with this item, as shown in Figure 9.2. Some respondents commented that VE in a project can only be effective if it is implemented at each stage. However, 15% of the respondents may have been confused about the prioritisation of the stages of VE.

On the basis of the results from Item 2, no changes were made in the proposed framework.

Item 3 - Organisation of workshops in VE

Figure 9.2 shows that the majority (70%) of respondents agreed with the organisation of workshops in VE. However, 30% disagreed but did not provide specific reasons in the questionnaire.

Influence on the proposed framework: no change.

Item 4 - Involvement of clients and contractors in VE

This question about the involvement of clients and contractors in VE received mixed responses. Figure 9.2 shows that the majority (60%) of respondents agreed with the involvement of clients and contractors in VE. However, 40% did not agree with the involvement of clients as they believed that clients could confuse the value engineers in terms of the project requirements, as each client has their own requirements and it is difficult to reach conclusions when several opinions are provided. On the other hand, 60% agreed with this item and suggested that a feedback session should be organised at this point in which clients can register their needs once they understand the offerings of the project. The feedback could be considered by the value engineers and contractors, as well as valid demands.

Influence on the proposed framework: a feedback session or system was incorporated in the framework.

Item 5 – Development of VE culture and environment

Figure 9.2 shows that the VE culture and environment also had approval from the majority of respondents, with 80% agreeing that it is important to plan and develop a VE culture and environment in an organisation. The remaining 20% did not believe in developing a VE culture and environment in an organisation because they felt that the implementation of such concepts would be time-consuming and costly.

Influence on the proposed framework: no change.

Item 6 - Abiding by the sustainability guidelines

Figure 9.2 shows that sustainability guidelines had support from the majority (90%) of the respondents. Most respondents supported abiding by the sustainability guidelines of the project, as they understood that this initiative will be helpful from both the regulatory and the corporate social responsibility (CSR) perspectives. The remaining 10% did not agree because sustainability guidelines are costly, which could impact the profitability of the project.

Influence on the proposed framework: no change.

9.7.2 Implementation stage

Item 1 – Organisation of workshops

This item on conducting workshops received the lowest agreement from the respondents. Figure 9.3 shows that only 40% of respondents agreed. Most respondents felt that it is not necessary to conduct a workshop twice as it will increase costs unnecessarily.

Influence on the proposed framework: for this item, the workshop needs to be organised once, in the planning phase. However, the literature suggests that many workshops should be conducted to improve VE in the planning and implementation stages (South Bay Construction, 2015); therefore, optional workshops can be added in the implementation phase.

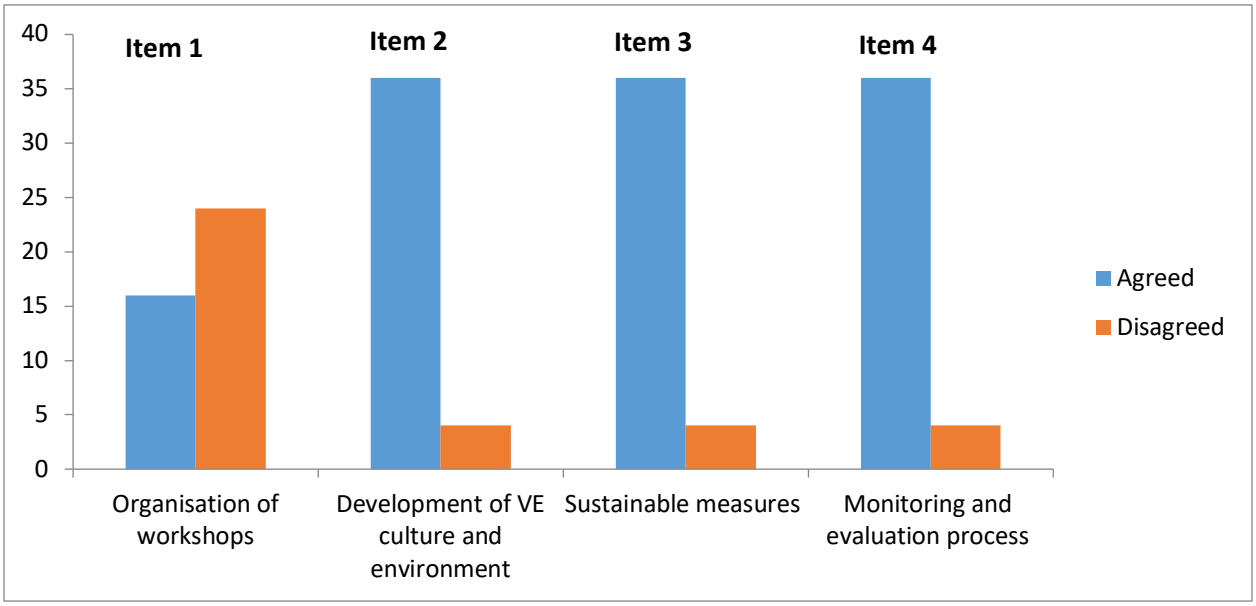

Figure 9.3: Responses to Item 1 to 4

Item 2 – Development of VE culture and environment

Figure 9.3 shows that the majority (90%) of respondents agreed with the implementation of a VE culture. They agreed that there must be practical steps towards the implementation of a VE culture and environment within an organisation as, only then, will employees switch to modern or technical means of construction. The remaining 10% did not agree as they felt it would increase costs.

Influence on the proposed framework: no change.

Item 3 – Sustainable measure

Figure 9.3 shows that 90% of respondents agreed that sustainable measures need to be implemented in order to comply with sustainability practices, and that contractors are responsible for this. However, this needs to be different from Item 6 in the planning phase. Ten per cent of respondents did not agree that sustainable measures need to be taken in order to comply with sustainability practices or that contractors are responsible for this because they felt that it is the duty of the company to ensure compliance with sustainability practices.

Influence on the proposed framework: the statement needs to be rephrased and elaborated in terms of context.

Item 4 – Monitoring and evaluation process

Figure 9.3 shows that the majority (90%) of respondents agreed that the monitoring and evaluation process needs to be carried out at regular intervals. Ten per cent of respondents did not agree that the monitoring and evaluation process needs to be carried out at regular intervals so that any discrepancies in the process can be found at the initial stages before they begin to impact the project significantly. The reason for this disagreement may be the costs involved in the monitoring and evaluation process.

Influence on the proposed framework: the process of monitoring, which can include auditing, can be written clearly into the model to provide clearer explanation. The frequency of monitoring also increases if monitoring and evaluation are given importance. In order to receive more accurate or precise results regarding the questions, only two response options (Agree or disagree) were offered to the respondents.

9.8 Response to validation process

On the basis of the results of the validation process, the following changes were introduced to the proposed framework:

Planning stage: Item 1

The methods that can be used for analysis of external and internal factors affecting the variables need to be mentioned in the framework.

Planning stage: Item 4

The incorporation of a feedback session needs to be planned after this item so that the requirements of the client can be understood and the contractors can carry out construction activities in accordance with such requirements. Therefore, feedback sessions were included in the routine process.

Implementation stage: Item 4

The monitoring method was incorporated into the framework. Each process is monitored at every stage so that discrepancies can be identified at an early stage.

9.9 Final version of the framework

Based on the above analysis and discussion, Figure 9.4 shows the final version of the framework that was developed. It incorporates all the changes that were made following the validation survey. This final version of the framework can be implemented by construction companies and other stakeholders involved in housing provision in the UAE. The stakeholders must consider the use of framework and its guidelines in their construction processes as only then will the housing projects be flawless and affordable.

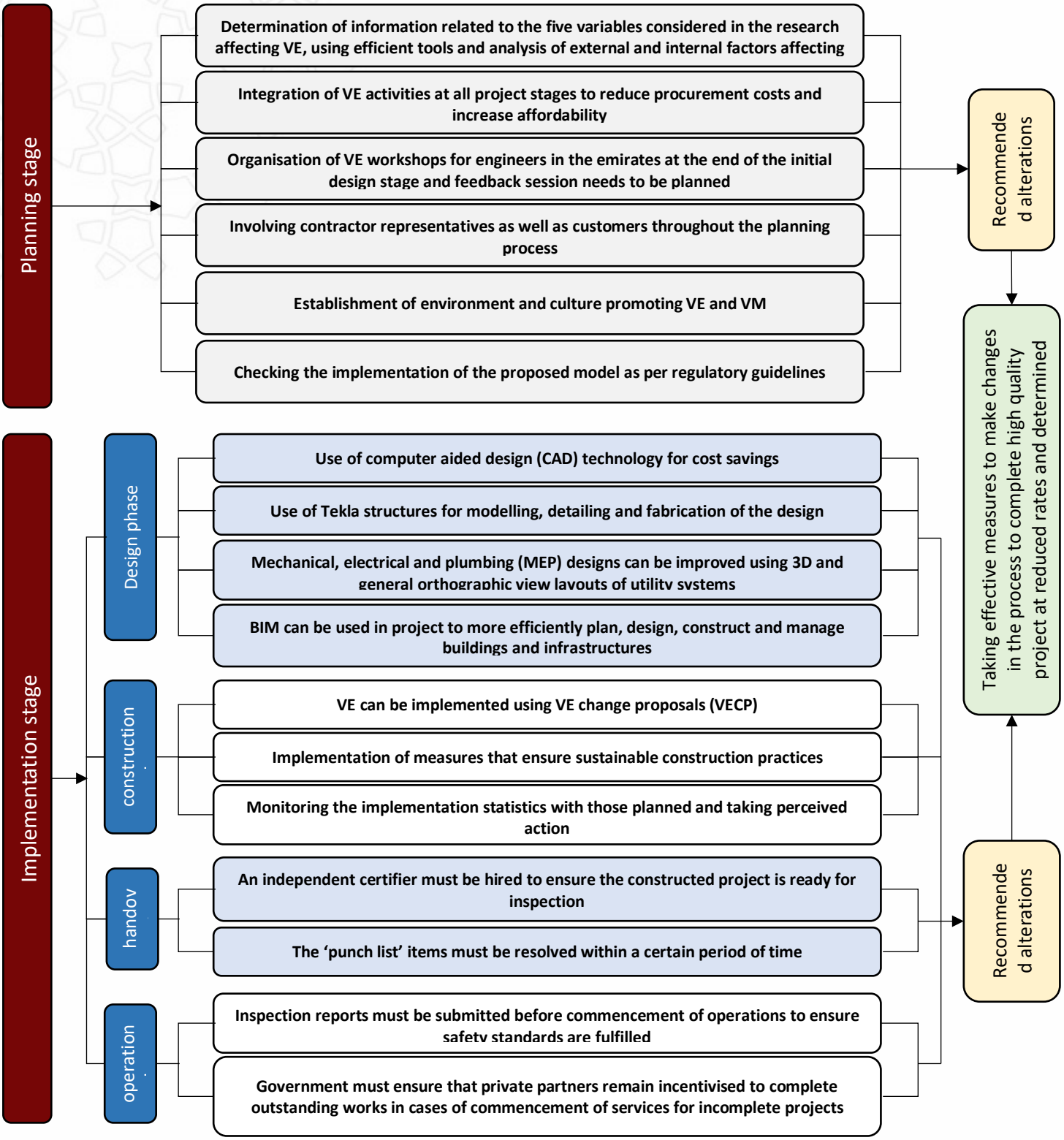

Figure 9.4: Revised framework for VE in UAE public housing projects

The framework developed above will foster the process of VE implementation in UAE housing projects. The framework offers new ideas that can improve the overall process of VE implementation. The framework focuses on the utilisation of new technologies and approaches such as VECP and BIM, considering the fact that the UAE government continuously focuses on improving its level technology adoption. The framework is reliable as it has been developed on the basis of information collected from a wide range of stakeholders involved in construction projects.

9.10 Discussion of the improvement factors

According to the study, VE and VM principles need to be integrated into all stages of construction: initiation and planning, design, construction and operation.

9.10.1 Improvements during the planning stage

The **planning stage** is the main phase in housing construction projects as it includes all designing strategies for the project decided during this phase; it also holds a place in creativity and innovation and, finally, the designed plan is implemented. The improvement factors for the planning stage of construction projects may include the following components:

1) **Determination of information related to the five variables considered in the research affecting VE, using efficient tools**

The study highlighted that VE impacts five major factors in housing construction projects: achievement of needs, conflict avoidance, affordability of housing, competitive advantage and cost of production. Therefore, requirements for the completion of a project must be included under these subcategories. This will help with the incorporation of all project requirements that are necessary to complete the project within determined deadlines and costs. Implementation of analysis tools such as multiple domain matrices, target costing and others can be extremely helpful in the identification of the important external and internal factors affecting these variables. The analysis will allow designers to incorporate systemic thinking and diagnosis of the factors that can impact these variables and strategic plans can be developed for the same (Behncke, Maisenbachera, & Maurer, 2014).

2) **Integration of VE activities at all project stages to reduce procurement costs and increase affordability**

VE principles need to be incorporated at all stages as determined in the literature review. Implementation at only at one stage may lead to the failure of the project. Therefore, to synchronise all project activities, VE needs to be implemented at all stages effectively. In addition, all tasks under all stages must be properly scheduled in terms of time and budget.

3) **Organisation of VE workshops for engineers in the Emirates at the end of the initial design stage**

SAVE International recommends that workshops are conducted for value engineers and contractors at regular intervals. Workshops must take place three days each year. These workshops allow the engineers and contractors to understand the major challenges they face during the planning and implementation stages and, thus, can help them to prepare the measures that can be taken when needed. In addition, they can be made aware of all planning procedures carried out for the project. The literature review also suggests that SAVE International recommends the organisation of such workshops before the start of a new project. However, such a recommendation is followed by major companies only, and on an irregular basis. Small construction companies or projects do not consider the use of workshops.

4) **Involving contractor representatives as well as customers throughout the planning process**

The end users must be included throughout the planning process so that they can be made aware of the facilities that will be provided. Contractors need to communicate with the clients about project inclusions to make sure the clients are satisfied. In addition, value engineers need to keep the contractors in the loop regarding all internal details of the project such as raw materials, procurement and costs. This will ensure that the practical aspects of construction are well considered and executed as per the planning, as value engineers plan projects on paper, whereas contractors work in the field and complete the projects and, therefore, actually determine the 'buildability' of the projects.

5) **Establishment of environment and culture promoting VE and VM**

The VE principles need to be well communicated to the population of employees working on the project. Therefore, there needs to be a culture supporting VE implementation in an organisation.

All designers, employees, contractors and facilitators must be made aware of the benefits of the VE principles and all information must be exchanged with the authorities as well as clients.

9.10.2 Improvements during the design stages

1) **Use of computer aided design (CAD) technology for cost savings**

The use of technology in the design process allows value engineers to reduce the costs of construction and improve productivity gains. Using CAD technology, critical design information can be obtained from the graphics layout. This will provide value engineers with multiple options to support the most structurally sound but economical options (Engineering division of 3Alpha Outsourcing Services, 2017).

2) **Use of Tekla structures for modelling, detailing and fabrication of the design**

Tekla is a design software that supports three main functions of structural engineering: detailing, modelling and fabrication. The information-rich database evaluates and analyses the most cost-effective solutions to be incorporated in the construction design model. It presents a 3D model of the project that will be constructed.

3) **Mechanical, electrical and plumbing (MEP) designs can be improved using 3D and general orthographic view layouts of utility systems**

MEP systems help with the cost- and time-effective installation and construction of utilities infrastructures. VE will help to conduct appropriate design calculations, layout comparisons and cost evaluations to derive the best solutions. MEP constructs are highly reliable when VE is employed for their installation. Third-party drafting vendors can be used to provide multiple layout solutions for MEP systems (Engineering division of 3Alpha Outsourcing Services, 2017).

9.10.3 Improvements during the construction phase

1) **VE can be implemented using VE change proposals (VECP)**

VECP can be used to create enhanced value for owners and provide them with financial benefits. It will allow constructors to change the order of events during construction and resolve issues relating to productivity and schedules to improve cost savings (National Institute of Building Sciences, 2018).

2) Implementation of measures that ensure sustainable construction practices

Sustainability guidelines such as Estidama apply to all construction projects in the UAE, to ensure that the materials and practices used during the construction of a project do not damage its sustainability. This is the major responsibility of the contractor, to take measures to ensure the sustainability of the project. If they fail to implement sustainability measures, this can result in heavy fines or pose other significant risks to the stakeholders.

3) Monitoring the implementation statistics with those planned and taking perceived action

This is one of the most important steps in the implementation phase. The construction of the project must be cross-checked with the planned guidelines, and this needs to be carried out at fixed intervals of three months. It will help to measure the discrepancies between the perceived and actual accomplishment of the project. It will also ensure that all risks are properly handled, as well as indicating the pitfalls that need to be avoided (Alkhereibi, 2017).

9.10.4 Improvements during the handover stage

1) An independent certifier must be hired to ensure the constructed project is ready for inspection

Usually, a certifier is required to provide certification to the construction firm to mark the project's completion. Therefore, it is beneficial for the firm to hire a certifier who can check the construction activities and recommend measures to incorporate changes to activities to ensure that all required standards are fulfilled.

2) The 'punch list' items must be resolved within a certain period of time

The independent certifier may provide the company with a list of certain items that need to be corrected before actual operations can commence under the required safety standards. This will allow the company to ensure the project is highly effective and successful and will also ensure that the project is not held up to due matters of non-compliance (APM Group Ltd., 2018).

9.10.5 Improvements during the operation phase

1) **Inspection reports must be submitted before commencement of operations to ensure safety standards are fulfilled**

The operation phase is when services commence after completion of the construction phase. Before services commence, reports will allow customers to trust the reliability of the product and make sure the residence is safe and secure.

2) **Government must ensure that private partners remain incentivised to complete outstanding works in cases of commencement of services for incomplete projects**

Occasionally, services commence for incomplete projects and outstanding works are carried out simultaneously. In such cases, the government must ensure that the private partner responsible for carrying out the outstanding tasks is properly incentivised so that the tasks are completed at the proper time and within the required safety standards (APM Group Ltd., 2018).

9.11 Benefits of this framework

This framework has been developed to plan the activities within the planning and implementation stages of construction projects in order to achieve the benefits of VE. VE enables designers to satisfy customers in terms of the quality of housing as well as providing them with housing facilities within an affordable price range. The major highlights of this framework in the planning phase are conducting analysis of internal and external environment to develop the strategies as per the requirements and needs of customers and integrating VE in every stage of the project. The main highlights of the framework at the implementation phase include development of an effective process of monitoring the progress of the project and development of the project as per sustainability guidelines. The major benefit of this framework is that it will help contractors to carry out tasks in a systematic manner and complete projects within the restricted guidelines of budget and time (Mostafaeipour & Sadra-Abarghouei, 2011).

9.12 When and how to implement the framework

The framework mentioned above will help contractors and constructors to complete projects within the restricted bounds of time and budget. Thus, this framework needs to be implemented in all construction phases. It can be launched as the standard framework by authorities in the construction business as early as possible, as it will sequence the procedures of construction and

include VE and VM at several steps to ensure they are more effective. The framework includes different steps that must be taken during the planning and implementation stages to ensure housing construction projects are more reliable, cost-efficient and flawless. The implementation of VE can be carried out largely during the planning stage, as this is considered to be the most important; as most decisions pertaining to the main activities to be undertaken throughout the project are made here. The planning stage also considers feedback from housing officers regarding decisions before any actual construction takes place. This ensures that the project is flawless and any future conflicts that might take place between different authorities can be resolved. In addition, the implementation of this framework in the construction phase will ensure that the project is completed within timed time intervals and budget. There will be a team of value engineers and contractors, who will carry out the implementation of these processes and report changes to the directors. Government authorities will also directly monitor the performance of this team and will examine their reports thoroughly.

9.13 Scope of the framework

Although the framework was developed within and for UAE housing projects, it can be used for different types of construction projects also. This is because the framework was developed by taking into account different factors influencing the success of VE's implementation. In addition, the opinions of several stakeholders involved in the different types of projects were considered in the development of the framework. Further, the framework can be used for VE implementation in housing projects in other countries, especially the GCC, as the earlier comparison revealed that housing programme goals are similar in most countries.

9.14 Summary of Chapter 9

This chapter has proposed a framework for VE and VM that can be implemented by constructors and architects in the housing industry to plan better projects and design better strategies regarding the completion of projects. The implementation of this framework is recommended for implementation during the planning and subsequent stages of construction by using VE and VM approaches.

The proposed framework was validated by conducting a survey among housing officers, value engineers and directors in the construction industry. On the basis of the survey responses, the proposed model was improved to conduct analysis of the internal and external environment to develop strategies according to the requirements and needs of customers and to integrate VE at every stage of a project. The framework also takes into account feedback from customers so that projects are developed according to their requirements and demands. The construction phase is intended to be modified in such a way that the development of effective monitoring of the progress and development of a project according to sustainability guidelines is ensured. The final framework suggested in this chapter will ensure that future housing projects are in compliance with the sustainability guidelines, avoid unnecessary conflicts of interest and provide high-quality housing facilities for people in the UAE at affordable prices.

CHAPTER 10 – CONCLUSIONS AND RECOMMENDATIONS

10.1 Introduction to Chapter 10

The UAE's construction industry has seen a boom in recent years due to increasing investment from abroad, along with the fact that the UAE has tried to widen the scope of its economy beyond the oil industry. The UAE government uses its oil revenues to improve the welfare of its citizens, and one area to which it devotes particular attention is housing. This study has established that the provision of public-sector housing in the UAE is not very efficient, and often results in time delays and higher prices. The aim of this research is to determine better alternatives for housing designs that feature improved quality and enhanced reliability in order to ensure the development of world-class housing facilities at affordable prices and customer satisfaction. The research also seeks to develop a framework based on the principles of VE and VM that is appropriate for the UAE housing sector.

10.2 Achieving the research aim and objectives

The research objectives were established as follows:

- To explore the role of VE and strategies for implementing it in the UAE's construction industry;
- To determine the challenges of implementing VE in the UAE;
- To determine the benefits of VM and VE, with the help of qualitative and quantitative research;
- To identify the impact of VE on the construction industry in the UAE.
- To determine the best practices associated with VE/VM for housing projects; and
- To develop guidelines for the use of VE to improve the provision of housing in the UAE.

These objectives have been fully achieved, as explained below.

Role of VE and strategies for its implementation in the UAE's construction industry

The literature review in Chapter 2 suggested that VE and VM are important practices that should be implemented in the UAE because they help to cut costs in several aspects of construction, which reduces the overall cost of projects and thereby increases the affordability of housing. They also contribute to the optimisation of construction designs that suit the needs of customers and ensure maximum customer satisfaction, and also ensure that projects are completed within restricted time periods, reducing rates of project failure to a minimum. Some of the factors that can be addressed with the help of VE and VM are traditional ways of thinking, poor communication, insufficient time to complete the job, beliefs in false structures, poor coordination between operations personnel and designers, limited skills and expertise, a lack of basic, valuable, and required information, and a lack of state-of-the-art technology.

Challenges in the implementation of VE in the UAE

The results of the literature review, as discussed in Chapters 2-4, revealed that the concepts of VE and VM are not implemented in full in the UAE. There has been a boom in architecture in the country, but smart architectural practices are still lacking, and firms need to employ both VM and VE in current construction practices to meet world-class standards. A major problem identified in the web research and literature review is that house prices in the UAE are very high, and it can be extremely hard for individuals and families to afford properties that meet their expectations. Housing projects often face delays for a variety of reasons. One of the major reasons why people in the construction industry have so far failed to adopt VE and VM practices is that they are not aware of the latest developments in this area. The culture of the country is also an influential factor because many citizens wish to maintain their culture, and prefer not to make use of innovative architectural practices for their homes. Other issues that were identified include the reluctance of employees to develop skills and performance with the help of training and development, high levels of resistance to change, and ambiguity in terms of vision.

Benefits of VM and VE, as revealed by qualitative and quantitative research

To identify the challenges facing and status of the implementation of VE and VM in the UAE, both primary and secondary research was conducted in the course of this study. The primary research saw the collection of first-hand data directly from constructors and other professionals.

The research followed both quantitative and qualitative approaches, whereby data were collected via a questionnaire distributed to 300 employees and professionals working in the construction industry, while qualitative information was collected in interviews conducted with the authorities in charge of the Sheikh Zayed and Sheikh Mohammed bin Rashid housing programmes. More details can be seen in the empirical investigation outlined in Chapters 7 and 8.

The data revealed that the majority of respondents supported the use of VE in UAE government housing projects (mean = 4.04, SD = 1.15) because doing so will create the best construction designs for construction engineers, and thereby ensure maximum customer satisfaction. Another finding is that many private companies that pursue construction projects have already implemented VE and VM, and that this is not a new concept in the country. The respondents agreed that firms should organise meetings and workshops to make people more aware of the benefits and practices of VE and VM (mean = 4.33, SD = 0.65). However, another finding was that professionals in the construction industry tend not to be satisfied with the implementation of VE (mean = 4.04, SD = 1.06); they stated that their roles and responsibilities are not clear, and that they are not prepared to use new practices or change current methods of organising housing projects. According to the respondents, it takes a significant amount of time to implement VE, while doing so can actually cause further delays. However, they also agreed with the statement that VE and VM should be implemented in the UAE, and that it is necessary to improve on the current ways in which it is employed (mean = 4.04, SD = 1.22).

The correlation between the five dependent variables in the study — achievement of needs, conflict avoidance, affordability of housing, competitive advantage, and cost of production — was analysed, as well as their correlation with the two independent variables, VE and VM in both design and procurement process. The findings indicate that all five dependent variables share a significant positive relationship with VE and VM. If the VE is used more often in housing construction projects in the UAE. It will be necessary to address all five variables to meet the end goal of customer satisfaction. According to the correlation analysis, 'VE in the design and procurement process' has the highest impact on 'the achievement of needs' (0.868), while the independent variables 'conflict avoidance' (0.826), 'affordability of housing' (0.817), and 'competitive advantage' (0.797) were also found to have a significant positive relationship with

the independent variables of VE and VM in design and procurement. Among the dependent variables, 'VE in the design and procurement process' exerted the least impact on 'the cost of production' (0.757).

Impact of VE on the UAE construction industry

The relationships discussed above show that these factors impact the procurement process, and that this process impacts VE and its implementation. This is very important because if the needs of customers and clients are not acknowledged, it will be difficult to complete a project effectively, and if the procurement process is not completed on time, projects will be delayed and the affordability of housing compromised. This study has shown that if they implement VE and knowledge management through VM, constructors in the UAE will be better placed to complete projects on time, satisfy customers with their designs, and make projects affordable. They also serve to reduce conflicts with clients and subsequent disputes. The government of the UAE has worked to promote VE practices in order to address all issues pertaining to the selected independent variables. However, housing projects in the UAE remain among the most expensive in the world, revealing the need to adopt certain measures in order to make housing projects in the UAE more affordable.

An analysis of the interviews conducted with senior managers revealed a need to implement VE in the planning phase of construction. The construction phase would also benefit from the principles of VE in order to ensure projects are completed effectively. In this phase, its implementation tends to reduce the costs of raw materials and ensures that the design of the building is achieved according to customer expectations and recommendations. This can be seen in more detail in Chapter 8.

Framework to improve the provision of housing in the UAE by means of VE

The VE model currently followed by constructors in the UAE can be broken down into two main phases: the pre- and post-VM methodology. This includes the VM methodology employed in the planning phase, and VE in the information phase, function analysis, creative phase, evaluation, development, presentation, and implementation. Another use of VE is to develop strategies in writing and to circulate them among team members to ensure their implementation in the later

stages. The proposed framework suggests the steps in which VE and VM can be best followed to ensure the project is completed efficiently and guarantees customer satisfaction. The framework suggests that it is most important to implement VE in the planning and construction phases; nevertheless, the techniques and practices of VE and VM should be adopted in all phases of construction. The proposed framework encompasses the steps that can be taken in the initiation and planning, design, construction, handover, and operations phases. The framework has been modified according to the results of the validation survey that was conducted with housing officers, value engineers, and directors in the construction industry. This is explained in more detail in Chapter 9.

Achieving the research goals

The above discussion makes it clear that all the research objectives have been fulfilled, the role of VE and strategies for its implementation in the UAE's construction industry has been explored and significant challenges identified in chapter 7 and 8. The use of qualitative and quantitative research in chapters 7 and 8 was essential in determining the benefits of VM and VE, and assessing their impact on the UAE construction industry. This study has also developed guidelines for the use of VE to improve the provision of housing in the UAE, and therefore the overall aim and goals of the research can be said to have been achieved.

10.3 Conclusions

This study has developed a framework that can be applied to the construction sector in the UAE to make housing projects more affordable and sustainable in order to meet the needs of clients and customers. The study has suggested that major changes must be made in the planning stage of projects because it is at this time that key plans are formulated. The implementation phase must also include changes designed to make housing projects better and meet the needs of customers.

The research conducted on VE has yielded deep insights in relation to its application in the construction industry. It was found that VE is a crucial technique that can help UAE companies to gain a competitive advantage in the construction and real estate industries, which are becoming increasingly competitive. This is achievable because VE improves the potential of organisations to complete construction projects within pre-specified times, costs, and levels of quality, which

will help to yield outcomes such as customer satisfaction. The procurement of raw materials is a major challenge for construction companies, and VE contributes to the procurement process by determining the optimum quantity of raw materials without unnecessarily increasing the costs of a project. By following the processes of VE, firms will be better positioned to focus on all important aspects of a construction project in a more effective manner. The issue of conflicts in construction projects has only been addressed to a limited extent. VE reduces the probability of conflicts in a project by ensuring that it is completed according to the time, specifications, budget, and quality specified by the client, and fosters a constructive form of communication among all parties involved. Better communication improves the overall quality of a project, and VE is suitable for affordable yet high-quality housing. If firms in the UAE make full use of VE, they will be able to guarantee that customers and citizens are able to buy houses that are low in cost but that also include facilities that meet international standards. However, the full advantages of VE can only be obtained if it is adopted at the inception phase of a project. VE can be used in combination with new forms of technology that are highly efficient in terms of managing designs and the associated costs such as CAD, VECP, and BIM. A glimpse into the UAE construction industry indicates that contractors and project managers face challenges in terms of time, cost, and quality, while it has become increasingly necessary to use modern methods such as VE and VM. The issues that arise in construction and housing projects in the UAE have a significantly negative impact on society, and the absence of VE has constrained local firms in terms of issues such as a lack of knowledge, professionals, and training. This being so, the UAE government should strive to increase the use of VE in the domestic construction industry so as to improve economic growth and customer satisfaction.

10.4 Scope and limitations of the study

The study was conducted in such a way to as to take account of all necessary precautions; however, there are still a number of limitations to this research. The literature review was conducted with great precision, and examined a wide range of articles published on the subject matter in question. However, there was scope for the inclusion of even more articles to perform additionally thorough research on the topic. The data collection was also efficient, but a greater number of respondents would have been worthwhile. Another factor is that the results of this research are limited to the

UAE housing sector, and future research could be conducted to produce results that can be applied to other economic sectors and countries.

10.5 Recommendations

Following the research and its conclusion, eight recommendations are made, as catalogued in Table 10.1, after which they are explained in more detail.

Table 10.1: Recommendation highlights

Recommendation	Directed to
1. Organise more workshops	Professional bodies, Ministry of Housing
2. Empower the right people	Housing Department
3. Use the new framework	Value engineers
4. Involve relevant stakeholders	Government or authoritative organisations, constructors
5. Create the right environment	Designers, contractors, facilitators, and employees
6. Use innovative concepts	Value engineers
7. Ensure sustainability	Society, government, and housing department
8. Introduce regulations to encourage the use of VE and VM	Government

- **Organise workshops:** As stated previously, VE is a vital concept in the efficient construction of housing projects. VE is a multi-step process that is carried out in the several project phases to ensure that every phase is completed with perfection so that the final outcome achieves the desired results. To implement VE in construction projects, the UAE government as well as private-sector organisations must organise workshops, which form part of the planning phase of VE. In these workshops, the proposed project is reviewed by a team of value engineers, a functional analysis is performed, the project specifications are compared with the owner's definition of value, the criteria of the project are defined, and all alternative solutions are considered in order to ensure that all the obstacles are dealt with and that customer satisfaction is guaranteed (South Bay Construction, 2015).

- **Empower the right people:** Value engineers must be hired by the government in order to ensure that construction projects are accomplished satisfactorily. If necessary, value engineers can be hired from countries in which VE is effectively used in construction projects, while the engineers should be highly experienced in implementing its concepts practically. They should

be allowed to handle all aspects of construction projects independently, just as project managers in organisations are given due authority to manage projects from the initial construction through to ensuring the sustainability of the sourced materials and their effective utilisation. Furthermore, the team must be allowed to bring social and environmental solutions to bear in construction projects, such as the use of safety equipment and steps to reduce the project's carbon footprint by utilising energy-efficient equipment such as LEDs and similar items (South Bay Construction, 2015).

- **Use the new framework:** Value engineers must follow the framework outlined in Section 9.9. Throughout all five stages of construction, it is necessary to abide by the suggested framework in order to ensure that projects are completed as envisioned. Furthermore, it is imperative to gather relevant information pertaining to the construction project such as how to achieve all desired outcomes, conflict avoidance, affordability of housing, a competitive advantage, cost of production, and the use of efficient tools in order to effectively plan and carry out the process of VE.

- **Involve relevant stakeholders:** An effective measure is to involve contractor representatives as well as customers throughout the planning process to ensure that the design basics are implemented and the designing process carried out according to the guidelines suggested by the government or authoritative organisations. The involvement of customers in the design process will allow constructors to identify the former's needs and demands and thereby complete the project according to the requirements. Doing so will help to guarantee customer satisfaction, which is ultimately the only thing that matters in such projects (Behncke, Maisenbachera, & Maurer, 2014).

- **Create the right environment:** It is necessary to establish an environment that is favourable for the implementation of VE and VM. In addition, the benefits of VE and VM should be communicated to all contractors and labourers, while builders, designers, and facilitators should also be made aware of the measures that must be taken to incorporate the principles of VE in construction.

- **Use of innovative concepts:** VE promotes the implementation of innovative concepts in design and architecture, as well as the use of the latest tools and technology in project design such as CAD and BIM, which can greatly reduce costs. Design fabrication, modelling, and detailing can all be managed using Tekla structures, and doing so makes it much more likely that a project is carried out in keeping with customers' demands, safety and wellbeing, and the quality of raw materials will be borne in mind. MEP designs produced using VE suggest the use of orthographic layouts for utility systems, as well as other 3D systems that can and meet global construction standards (Engineering division of 3Alpha Outsourcing Services, 2017).

- **Ensure sustainability**: Sustainability must be ensured during a project, and this includes obtaining and handling raw materials carefully. The carbon footprint of the construction process must be kept to a minimum and the MEP design developed in such a way so as to meet the needs of sustainability. The planning phase needs to include all required measures, with the methods cross-checked at every stage to ensure that the project is going as planned.

- **Regulations to encourage the use of VE and VM:** The government would do well to take adequate measures and make it compulsory for both public and private construction companies to implement VE and VM measures, and include such steps in reports. It would also be useful for the government to organise workshops to ensure that employees and professionals in the construction industry are aware of the effectiveness and benefits of VM and VE. Another beneficial development would be for the government to introduce guidelines to check that VE methods are followed in accordance with sustainability guidelines to reduce the national carbon footprint of the UAE (Behncke, Maisenbachera, & Maurer, 2014).

10.6 Contribution to knowledge

This research has sought to add relevant knowledge to the literature in the field of value engineering in the construction industry. The findings reveal that the main issue facing the UAE construction industry is that current players routinely fail to ensure customer satisfaction, and that one central reason for this is delays in project completion. Another finding is that the use of VE helps to significantly improve construction processes, but that the culture of the UAE reduces the effectiveness of its implementation. The framework proposed to address these shortcomings

focuses on the use of VE in the planning and construction phases of projects. One measure suggested in the new framework is to establish a culture across the UAE that appreciates VE and VM. Five variables that need to be addressed in construction projects are the achievement of needs, conflict avoidance, the affordability of housing, gaining a competitive advantage, and the cost of production. Additional measures include: VE should be integrated in all stages of construction activity; a range of workshops should be held; measures should be adopted that facilitate sustainable construction practices; and monitoring tools and techniques should be implemented that are based on favourable statistics. The framework proposed in this paper clearly states the roles and responsibilities of concerned persons, and how they should be followed to ensure the successful implementation of VE in UAE construction projects. If implemented, this research can be said to have helped to bring about a cultural change in the UAE construction industry, and to have facilitated the use of VE and VM across the emirates.

Overall, the contributions to knowledge of this study are: 1) VE/VM impacts on the achievement of needs most in the UAE; 2) culture is a hindrance to the full implementation of VE/VM in the UAE; 3) lack of awareness is another impediment to the use of VE/VM in the UAE; 4) proper guidance is not available for implementing VE/VM principles in UAE housing programmes: and 5) a new and validated framework which is proposed in this thesis will make UAE housing delivery to be more efficient, beneficial and satisfactory to clients and stakeholders.

10.7 Recommendations for future research

The research has added to the existing literature related to value engineering and its implementation in the construction industry, especially in the UAE. However, there remain many areas in the construction sector that still await an evaluation in terms of the impact of VE. For example, the research has not discussed the technical implementation of VE, so future research would do well to develop technical frameworks in order to test the importance of VE in other construction sub-sectors.

Another limitation of this research is that it was restricted to the UAE and wider GCC region; this being so, future studies on VE in the construction sector could expand to look at other countries, such as those in Asia, Europe, or North America. Doing so would widen the scope of research on

this subject matter, and offer a clear and more effective picture of the implementation of VE in the construction industry across many nations. The new framework proposed in this research is specific to the conditions of the UAE, so it is recommended that this framework be tested in other countries so as to identify what alterations could be adopted across the board, depending on other local circumstances.

The research has also not considered other constraints of this project such as the effects of time and costs; future researchers should address this deficit so as to complete the understanding of this topic which the literature reports to be wide.

10.8 Dissemination

The dissemination of the findings is an important aspect of the research process. It involves the transfer of research-based knowledge to others who can use it to their benefit. The major aims behind the dissemination of the findings of this research would include boosting the general understanding, awareness, and actions regarding the implementation of VE in the UAE construction industry. This research has not yet been published in any conference or journal papers, and the candidate is exploring potential outlets through which to disseminate the outcomes.

10.9 Overall Summary

This study has achieved the goals and objectives established at the outset, and successfully evaluated the relationships between the variables of the study. The research methodology adopted was in congruence with the scope and objectives of the project. The concepts of value engineering and value management overlap, but are also very different. Value engineering is a subcategory of value management, while VE is concerned with the design and procedures necessary to achieve and implement value management. In this study, VE has been used to further enhance the VE systems that are currently in use in the UAE housing construction sector. With the help of the selection of appropriate variables, this study has been able to establish that VE/VM in both design and the procurement process impacts on: achievement of needs, conflict avoidance, affordability of housing, competitive advantage and reduced cost of production. This influence must thus be reflected in the planning and execution of housing projects in the UAE. Hence a new VE implementation framework that is able to improve the performance of the UAE (housing)

construction sector was developed with respect to benefitting project outcomes in terms of cost, time, quality, customer satisfaction, etc.

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APPENDIX I: ETHICAL APPROVAL FORM (FACULTY OF SCIENCE AND ENGINEERING)

Survey input field	Respondent's answer
Name:	Sultan Rashid Ali Alktebi

1. Please enter your surname and first name below. (SURNAME, FIRST NAME)
Sultan Alktebi

2. Please enter your University email address (e.g. M.Name@wlv.ac.uk)
[email address redacted]

3. Please enter the name of your Director of Studies, Principal Investigator or, for Principal Investigators, your line manager.
Dr Ezekiel Chinyio

4. Please enter date by which a decision is required below. (Note that decisions can take up to 4 working weeks from date of submission)
06-02-2018

5. Which subject area is your research / project located?
1. **Architecture and Built Environment** 2. Biology, Chemistry and Forensic Science 3. Engineering 4. Life Sciences 5. Mathematics and Computer Science 6. other

6. Please select your School
1. School of Architecture and Built Environment 2. School of Biomedical Science and Physiology 3. School of Biology, Chemistry and Forensic Science 4. School of Engineering 5. School of Mathematics and Computer Science 6. School of Pharmacy 7. Other (please specify below)

7. Does your research fit into any of the following security-sensitive categories? (For definition of security sensitive categories see RPU webpages (www.wlv.ac.uk/rpu) follow links to Ethical Guidance).
1. Commissioned by the military 2. Commissioned under an EU security call 3. Involve the acquisition of security clearances 4. Concerns terrorist or extreme groups 5. Not applicable

8. Does your research involve the storage on a computer of any records, statements or other documents that can be interpreted as promoting or endorsing terrorist acts?
1. YES 2. NO ✓

9. Might your research involve the electronic transmission (e.g. as an email attachment) of any records or statements that can be interpreted as promoting or endorsing terrorist acts?
1. YES 2. NO ✓

10. Do you agree to store electronically on a secure University file store any records or statements that can be interpreted as promoting or endorsing terrorist acts. Do you also agree to scan and upload any paper documents with the same sort of content? Access to this file store will be protected by a password unique to you. Please confirm you understand and agree to these conditions?
1. YES, I understand and agree to the conditions – NB: my research has nothing to do with terrorism 2. NO (please explain below) 3. I do not understand the conditions

11. You agree NOT to transmit electronically to any third-party documents in the University secure document store?
1. YES, I agree ✓ 2. NO, I don't agree

12. Will your research involve visits to websites that might be associated with extreme, or terrorist, organisations? (for definition of extreme or terrorist organisations see RPU webpages (www.wlv.ac.uk/rpu) and follow links to Ethical Guidance.
1. YES (Please outline which websites and why you consider this necessary) 2. NO ✓

13. You are advised that visits to websites that might be associated with extreme or terrorist organisations may be subject to surveillance by the police. Accessing those sites from university IP addresses might lead to police enquiries. Do you understand this risk?

1. YES, I understand ✓
2. NO, I don't understand

14. What is the title of your project?

Implementation of Value Engineering Methodology in the Construction of Housing Projects in the UAE

15. Briefly outline your project, stating the rationale, aims, research question / hypothesis, and expected outcomes. Max 300 words.

Rationale

The cost of housing projects in the United Arab Emirate is increasing; one of the reasons behind this can be the use of traditional methods in the construction of the housing projects. Apart from the cost issues the construction industry of UAE is also facing the issue of delays. Quality, cost and timely delivery of the projects are the pillars of the construction industry. The UAE's construction industry is failing to achieve its basic objective. This research therefore focuses on value engineering that can be used to achieve the objectives of quality, cost and timely delivery. It is essential for the UAE construction industry to employ modern methods in construction rather than depending on only traditional methods.

Aims

The major aim of this research is to determine how value engineering can be integrated with the construction industry in UAE. In order to fulfil this, aim the focus will be on the tools, principles and methodologies of value engineering. Further the study aims at finding the relationship between the variables of the study. The dependent variables of the study are - Value Engineering in Design in Procurement Process. The independent variables of study are – cost of production, competitive advantage, conflict avoidance, achievements of needs and affordability of housing.

Research Question

1. What are the major issues in the UAE's construction industry?
2. What is value engineering?
3. How can value engineering be implemented in the UAE's construction industry?

Expected Outcomes

The expected outcomes of the study are that there is a positive relationship between the dependent and independent variables of the study. In other words, it can be said that value engineering will help in reducing the cost, gaining a competitive advantage, avoiding the conflicts, achievements of needs along with maintaining the affordability of housing.

16. How will your research be conducted? Describe the methods so that it can be easily understood by the ethics committee. Please ensure you clearly explain any acronyms and subject specific terminology. Max 300 words
The research is associated with the implementation of value engineering methodology in the construction of housing projects in UAE. In order to conduct this research, both the qualitative and quantitative research approach will be used so that the problem can be investigated in depth. For the qualitative research, interviews will be conducted with 300 respondents selected from the construction and real estate industry. The respondents have been selected with the help of simple random sampling that is a type of probabilistic sampling method. The probabilistic sampling offers the probability of involving each and every participant of the population in the study. This sampling method helps in eliminating the sampling errors and biases. The interview will contain 12 open ended questions so as to gain the detail view of respondent's view. Further the survey will be conducted with 300 respondents of the study with the help of a questionnaire. The questionnaire will contain questions for each of the variable of this study. This will help in determining the relationship between dependent and independent variables of the study. Questionnaire will be used for collecting the primary data and the literature review will be used for collecting the secondary data. Further, the hypothesis will also be developed and the data analysis tools T-test or regression or ANOVA, will be investigated for accepting or rejecting the hypothesis. A mixed research approach has been used in this study involving both the qualitative and quantitative research so that the problem of implementing value engineering methods and the problems associated with traditional construction methods can be deeply explored. The research methods that will be adopted in this research will be consistent with the research objectives and research questions and will help in achieving the research objectives.

17. Is ethical approval required by an external agency? (e.g. NHS, company, other university, etc.)
1. NO 2. YES - but ethical approval has not yet been obtained 3. YES - see contact details below of person who can verify that ethical approval has been obtained)

18. What in your view are the ethical considerations involved in this project? (e.g. confidentiality, consent, risk, physical or psychological harm, etc.) Please explain in full sentences. Do not simply list the issues. (Maximum 100) words)
Ethics can be defined as the set of rules that are written or unwritten; this research has been governed by the ethics. Some of the ethical considerations that have been involved in this research are (1) Confidentiality: For ensuring confidentiality, the responses of respondents and all the sensitive information such as the company's information will be protected. In this context different steps will be adopted such as data encryption and password protection. (2) Informed consent: it is the consent of the respondents for providing the response without any element of force, duress or fraud. Sufficient information will be provided to the respondents regarding the survey/interviews so they can make an informed decision, and (3) Physical or psychological harm: as this research involves no risky activities so no harm will be caused to any individual in this research physically or psychologically

19. Have participants been/will participants be, fully informed of the risks and benefits of participating and of their right to refuse participation or withdraw from the research at any time?
1. **YES (Outline your procedures for informing participants in the space below.** 2. 2. NO (Use the space below to explain why)
The participants of the study will be informed about the purpose of research. Also, the participants will be informed that all information provided by them will be treated in very strict confidence. Their identity and the name of the organisation will not be revealed in any report. The respondents will be clearly explained that their participation in survey/interview is voluntary and they have full rights to refuse or withdraw from the research at any point of time.

20. Are participants in your study going to be recruited from a potentially vulnerable group? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of vulnerable groups)
1. YES (Describe below which groups and what measures you will take to respect their rights and safeguard them) 2. **NO**
In this study, there are no participants who are recruited from a potentially vulnerable group. Vulnerable participants can be defined as the participant who lacks the ability to have a full consent to participate in the study. In this study no such participant is involved. The participants of the study included the managers and executives from the construction and real estate sector who will sign the consent form to participate in the study.

21. How will you ensure that the identity of your participants is protected (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for guidance on anonymity)
Protecting the identity of the participants is known as anonymity. Anonymity can be protected in two ways- the research will not collect the personal information of the subjects such as their name, email id, address, etc. or if collected the research cannot link the response with the identities of respondents. In this research, no personal information such as name, email address, address etc. will be collected from respondents.

22. How will you ensure that data remains confidential ((See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of confidentiality)
Maintaining the confidentiality of the data collected from respondent's means that only researcher and the individuals involved in research team will be able to identify the responses of the subjects. Therefore, different steps will be taken in order to maintain the confidentiality of this research such as – all the identifiable data will be encrypted, the face sheets of the survey instruments that contain identifiers will be removed. The access to all the identifiable information will be limited to research team. Further, the data documents will be stored in locked locations and the security codes will also be assigned to all the computer records.

23. How will you store your data during and after the project? (See RPU website (www.wlv.ac.uk/rpu) and follow link to Ethical Guidance pages for definition of and guidance on data protection and storage).
Storing the data during and after the research is one of the most important part of research ethics. In order to ensure it in this research all the possible measures will be adopted. The hard copies such as the interviews and survey instruments will be locked in a filing cabinet and can be assessed only by the team members. The computer files containing research data and identifiable data come under the Data protection Act therefore these files will be encrypted and protected with a password. The anonymised computer files also need to be held securely by password protection and encryption

APPENDIX II: QUESTIONNAIRE USED FOR THE SURVEY

Question	Sub-question
What is your gender?	
What is your current designation (or job title)?	
	If the response if Other, please specify
How long have you been working with your present organisation?	
What is your age?	
What is your highest educational qualification?	
What type of organisation do you work with?	
	If the response if Other, please specify
Have you participated in Value Engineering (VE) before?	
How would you rate your level of experience with VE?	
How would you rate your level of experience of the construction industry in general?	
How would you rate your level of experience of housing construction in the UAE?	
How would you rate your level of experience of value engineering?	
A. Cost of Production	A1. VE proposes the use of less expensive alternative materials.
	A2. The design for construction is modified during VE so that efficiency can be improved.
	A3. VE helps in reducing errors and hence reducing the cost of mistakes.
	A4. VE critically analyses the processes of housing construction so that cost can be reduced at each of the project phases.
	A5. VE can help in making UAE housing projects more affordable.
	A6. VE helps in reducing the cost of production.
B. Competitive Advantage	B1. VE contributes in customising designs for construction according to customers' needs.
	B2. All the requirements of the customers are fulfilled through VE.
	B3. VE helps in the timely completion of projects.

Question	Sub-question
	B4. VE helps in achieving quality along with reducing cost.
	B5. VE increases the customer's satisfaction because of reduced cost and improved quality.
	B6. VE optimises the balance between the expectations and needs of the different stakeholders involved in the delivery of housing projects.
	B7. VE helps in providing robust designs.
	B8. VE helps in obtaining funds easily.
C. Conflict Avoidance	C1. Conflicts between participants in VE do reduce the quality of housing projects.
	C2. Conflicts between participants in VE do increase the time for completing housing projects.
	C3. Conflicts between participants in VE do increase the cost of providing housing projects.
	C4. VE helps in cutting down unnecessary lines of communication.
	C5. VE improves the overall management of housing projects.
	C6. VE improves the clarity of goals of each housing project.
	C7. VE helps in developing a positive, supportive and cooperative attitude in the project team.
	C8. VE helps in developing a positive, supportive and cooperative attitude among all stakeholders.
	C9. VE has an inherent effective feedback system.
	C10. VE helps in proper coordination between multi-disciplinary teams.
	C11. Conflicts in projects are reduced because errors in specifications are reduced during VE.
	C12. VE helps in meeting statutory requirements.
	C13. VE helps in improving safety.
	C14. The use of VE reduces the likelihood of disputes in a project.
	C15. The use of VE reduces the number of disputes in construction projects.
D. Achievement of Needs	D1. VE helps in fulfilling even the minute requirements of customers.
	D2. VE helps in the modification and standardisation of construction projects.
	D3. VE has a potential to fulfil the consolidated requirements of all stakeholders in UAE housing.
	D4. VM uses the latest facts for different construction phases.

Question	Sub-question
	D5. It is easier to make project changes at any point of time through VE.
	D6. VE reduces the response time on issues pertaining to the customers.
E. Affordability of Housing	E1. VE increases the affordability of housing projects by reducing the expenses.
	E2. VE helps in cost control and management.
	E3. VE reduces the project cost without affecting its quality.
	E4. For contractors, VE helps in increasing the profit margins obtainable from housing projects.
	E5. VE makes housing affordable to medium-income earners.
	E6. VE reduces the engineering overhead costs.
	E7. VE helps in the understanding of design implications.
F. Value Engineering in Design	F1. The design of a project is critically analysed in VE.
	F2. VE helps in controlling the project outcomes.
	F3. VE helps in coordinating all stakeholders' ideas.
	F4. VE focuses construction by aligning it with different disciplines.
	F5. VE uses rational logic and analysis so as to identify the relationships that can improve the value of a project.
	F6. VE eliminates the non- essential elements of a project.
	F7. VE adds essential elements to housing projects.
	F8. VE helps in detecting and reducing the risks in projects.
	F9. VE provides a comprehensive view of the complete project.
	F10. Without VE, others cannot contribute to the design of housing schemes.
G. Value Engineering in the Procurement Process	G1. VE helps in identifying alternative materials for projects.
	G2. VE helps in deciding the optimum quantity of the materials to be ordered.
	G3. VE focuses on resource optimisation.
	G4. VE helps in procuring materials at the right time.
	G5. VE helps in procuring materials at the right cost.
	G6. VE prevents the wastage of materials.
	G7. VE works well with the traditional form of procurement.

Question	Sub-question
	G8. VE works well with 'Design & Build' procurement.
	G9. VE works well with the procurement of raw materials.
H. Implementing VE in UAE housing	H1. VE is fully implemented in Government-sponsored housing projects in the UAE.
	H2. VE is fully implemented in privately-sponsored housing projects in the UAE.
	H3. A standard protocol is followed while implementing VE in housing projects in the UAE.
	H4. Implementing VE in construction involves many workshops/meetings.
	H5. Participants in the UAE are usually not happy to be involved in VE.
	H6. The process of VE in construction projects takes a long time.
	H7. The cost of implementing VE in construction projects in the UAE is very high.
	H8. The gains of VE in construction outweigh the cost and time commitments required for carrying it out.
	H9. The importance of VE in construction is not fully understood by the relevant stakeholders.
	H10. There is a need to increase the frequency of implementing VE in construction in the UAE.
	H11. There is a need to improve the implementation of VE in construction in the UAE.
	H12. A guideline is needed for implementing VE in housing construction in the UAE.
	H13. A guideline is needed for implementing VE on all types of construction projects in the UAE.
	H14. A Government policy is needed for promoting the implementation of VE in housing construction in the UAE.
	H15. A Government policy is needed for promoting the implementation of VE in all types of construction projects in the UAE.
	H16. There is a need for the proper monitoring of VE program performance.
	H17. For the effective implementation of VE in the UAE, training should be provided to staff that would carry it out.
	H18. VE team facilitators should have proper credentials.
I. Knowledge Management in VE in UAE construction	I1. VE in UAE construction should be fully recorded.

Question	Sub-question
	I2. VE in UAE construction should be recorded in a standardised manner.
	I3. The records of any VE exercise should remain a confidential project affair.
	I4. A scale should be created for measuring the gains and pains of VE in the UAE.
	I5. A national data repository should be created for feedback on VE.
Comment generally, if you wish, on using VE for improving the provision of housing in the UAE	Open-Ended Response

APPENDIX III: DESCRIPTIVE STATISTICS OF QUESTIONNAIRE DATA

Table 0.1: Descriptive statistics

Description	N	Mean	Std. Deviation
VE is fully implemented in Government-sponsored housing projects in the UAE.	102	4.04	1.15
VE is fully implemented in privately-sponsored housing projects in the UAE.	102	4.12	.97
A standard protocol is followed while implementing VE in housing projects in the UAE.	102	4.06	.90
Implementing VE in construction involves many workshops/meetings.	102	4.33	.65
Participants in the UAE are usually not happy to be involved in VE.	102	4.04	1.06
The process of VE in construction projects takes a long time.	102	4.08	1.07
The cost of implementing VE in construction projects in the UAE is very high.	102	3.96	1.18
The gains of VE in construction outweigh the cost and time commitments required for carrying it out.	102	4.16	.81
The importance of VE in construction is not fully understood by the relevant stakeholders.	102	4.16	.87
There is a need to increase the frequency of implementing VE in construction in the UAE.	102	4.44	.64
There is a need to improve the implementation of VE in construction in the UAE.	102	4.43	.73
A guideline is needed for implementing VE in housing construction in the UAE.	102	4.51	.61
A guideline is needed for implementing VE on all types of construction projects in the UAE.	102	4.39	.63

Description	N	Mean	Std. Deviation
A Government policy is needed for promoting the implementation of VE in housing construction in the UAE.	102	4.45	.64
A Government policy is needed for promoting the implementation of VE in all types of construction projects in the UAE.	102	4.43	.70
There is a need for the proper monitoring of VE program performance.	102	4.47	.61
For the effective implementation of VE in the UAE, training should be provided to staff that would carry it out.	102	4.49	.58
VE team facilitators should have proper credentials.	102	4.47	.70
VE in UAE construction should be fully recorded.	102	4.53	.58
VE in UAE construction should be recorded in a standardised manner.	102	4.55	.70
The records of any VE exercise should remain a confidential project affair.	102	4.04	1.22
A scale should be created for measuring the gains and pains of VE in the UAE.	102	4.46	.65
A national data repository should be created for feedback on VE.	102	4.53	.67
Valid N (listwise)	102		

APPENDIX IV: SELECTION OF INTERVIEW ANSWERS

1. What are the major challenges in housing construction projects in the UAE?

The responses to this question can be classified as:

Major identified challenges	No. of respondents supporting the challenge
Increment in the variety of usable materials	3
Increase in the prices of materials and equipment	10
Compliance with government standards and regulations of construction of housing projects	5
High procurement costs	12

The major challenges in the housing industry in UAE are related to the procurement and high budget, which hamper the housing affordability in the nation. One of the respondents said that, 'the increase in costs of the construction projects is due to the increment in the variety of materials which can be used for making the buildings in UAE. The increase in the prices of these materials presents the challenge of high costs'. The others responded by saying, 'development of corporate and large-scale residential buildings have to follow a number of regulations, which further add to the increased costs'. A few experts also highlighted that, 'the increase in the procurement costs adds to the overall value of the buildings, which makes them less affordable for the people'.

2. How do you think Value engineering and analysis is helping or hindering the delivery of housing projects in the UAE?

Value engineering is increasing the quality of construction of housing projects all across UAE. 25 out of 30 respondents were in support of this claim. They said, 'The value engineering helps in finding the alternatives for the materials which can be used for carrying out the construction projects, which improves the quality of construction as well as reduces the costs of construction'. However, one of the experts said that, 'value engineering is not that beneficial in the context of UAE as it increases the overall time required for construction'. Another interviewee added that, 'VE does not hold much importance for UAE or other Asian countries as these nations lack the required workforce and the technical skill set for applying value engineering'. Most of the

responses were in favour of implementation of value engineering and they focused on developing the skill set in employees through training and development.

3. What are the major barriers associated with the implementation of value engineering and management?

This question asked about the major barriers faced by UAE in implementing the Value engineering and value management in a full-fledged manner. Out of 30 respondents, more than 20 respondents mentioned that the lack of training and development is the major barrier behind the implementation of value engineering in an effective manner. One of the respondents said, 'There are not sufficient workshops and sessions organised in UAE regarding the implementation of Value engineering and thus, VE is not implemented in the country in a fully effective manner. This field requires in-depth knowledge and needs special training workshops to be organised at regular intervals to train the construction employees in an effective manner'. This response highlights all the problems. Another appealing response was, 'the communication between the designers and the value engineers is very restricted and the designers are not aware of the key benefits and approaches of value engineering'. Another respondent answered that, 'the role of government in promoting value engineering is also limited and it also needs to be enhanced to implement the concept on a wider scale'.

4. What are the main benefits of VE in the UAE?

The responses to this question can be classified as:

Major benefits	No. of respondents supporting the benefit
Improved housing affordability in UAE	21
Decrease in the prices of materials and equipment	20
Compliance with government standards and regulations of construction of housing projects	12
Reduced procurement costs	21
Saves cost and time	17
Better quality in construction	24
Improved customer satisfaction	20

The major benefits of implementing value engineering in housing construction projects, highlighted through the interview of the construction experts included, affordability, reduction in

the costs of procurement, improved customer satisfaction and better quality. Most of the experts associated VE with reduction in the costs for procuring the raw materials. One respondent said, 'VE presents the designers with a series of alternatives related to the raw materials, which helps in choosing the cheapest and the best suited alternative, which may influence the costs of procurement and prove to be beneficial for the entire project'. Another added, 'VE and VM helps in reducing the time of construction, improving the quality of project and improving the functionality of house. This further improves the satisfaction of the customers regarding their housing projects'.

5. How frequent is VE used in the delivery of projects in UAE?

This question was related to the frequency of implementation of VE in UAE. The implementation of VE is very limited in UAE. The major barriers behind its proper implementation are mentioned above such as, lack of training and workshops, limited awareness about its importance and restricted government regulations and policies. Thus, there is a need to improve its frequency. One manager responded to this question in the given manner, 'of course, there is need to implement VE in UAE after knowing the excessive benefits it presents for the people. For increasing its implementation, it is necessary that the training sessions for it are organised well and government policies and regulations favour the same'. Another manager also supported this claim by saying, 'in my opinion, VE must be introduced in the construction courses so that the workforce of the nation gathers its skills from the very beginning'.

6. How frequent is VE used in the delivery of housing projects in the UAE?

This project highlights the implementation of VE and VM practices especially in the housing projects of UAE. According to most of the responses, it can be said that the implementation of VE is very limited in the housing projects and is rarely considered. One of the respondents mentioned in the interview that, 'VE is not given up to the mark importance in the construction projects in UAE. However, when it comes to implementation of VE in the housing construction sector, the statistics are even lesser'. Another respondent added, 'The commercial sector of UAE is realising the benefits of VE and has started using the practices. The housing industry still has to wait for the revolution'. Most of the respondents gave the similar answers to this question.

7. At which project phase, is VE currently used in project delivery in the UAE?

The responses to this question can be classified as:

Phases of Value engineering	No. of respondents supporting the phase
Initiation and conception	10
Planning	12
Execution	3
Evaluation	3
Closure	2

This question evaluates the stage of actual implementation of VE in the delivery of projects in UAE. As the table shows, most of the respondents stated that VE practices find their application in the planning phase of the projects. One of the interviewees said, 'Value engineering is far from actual implementation in UAE. The commercial projects are planned using principles of value engineering but, the implementation of value engineering in housing projects is limited'. Another added, 'The projects are planned keeping a few principles of VE in mind but when it comes to implementation, the traditional methods are given more preference.' However, a few respondents also voted for the first phase, it can be said that VE is applied in the initial two phases of construction project.

8. At which project phase should VE be used in project delivery in the UAE?

The responses to this question can be classified as:

Phases of Value engineering	No. of respondents supporting the phase
Initiation and conception	5
Planning	7
Execution	10
Evaluation	7
Closure	1

In this question, it was asked that in which phase, the VE must be implemented in the organisation. As the table shows, most of the respondents voted for the execution phase. One respondent said, 'The VE concepts must be taken forward and the execution of the project must be based on the guidelines settled by VE and the skilled designers'. Another also supported the claim by saying, 'the implementation of VE during these phases allows the constructors to get the latest information

related to the same as well as allows them to procure the materials at the lowest possible costs'. Other remarkable answer included the following words, 'VE is the technical and innovative approach which must be implemented beginning from planning till the evaluation and closure of project. It will bring modern approaches and skillet into account and innovation is always for betterment'.

9. How do you manage the challenges, if any, of Value engineering and management?

The experts were asked about the approaches they undertake to manage the challenges related to VE and VM which come their way. One respondent said, 'the major challenges faced by us while implementing the VE in all the construction processes and phases are the lack of knowledge regarding value engineering in our teams'. Most of the experts highlighted communication as the key to this challenge. One of them said, 'Meetings and workshops are the best approaches we can think as of now. Meetings will allow us to teach the importance of these measures to the team and workshops will provide them with necessary training'. The major emphasis of the experts was on training and development of the employees regarding the required skill set. Another employee added, 'We have organised a few meetings with the government officials as well so that they may take bureaucratic steps towards developing a value engineering friendly policy to promote this concept in the housing construction industry'.

10. How do you ensure the accuracy of data collected for value engineering and management?

'The value engineering is all about collecting latest facts about the construction industry and required materials and equipment. For this, a number of data collection tools such as survey, interviews, web research and such others are used', one of the responses mentioned. Another respondent confirmed the fact by saying, 'we choose the alternative which is the best blend of schedule, cost and performance'. Majority of the respondents voted for matrix analysis as the most effective tool for checking the collected data. A few others highlighted data validation, cost estimates and assessment through sketches as other potential methods for data evaluation. One of the interviewees said that, 'the collected data needs to be well evaluated for its significance and we prefer doing it through Pareto analysis as it helps in getting the perfect estimates of budget, quality and time'.

11. How are data that are used in VE preserved?

This question enquired about the best practices which can be used for the preservation of the data of value engineering. As mentioned above, VE is all about data collection and using the collected data for future reference. According to one interviewee, 'The data collected using the principles of VE helps in improving the quality of construction practices and the information about the materials that can be used for fulfilling the construction requirements'. 'The data is preserved using the computerised and manual records' as mentioned by one of the interviewees. The preservation of data helps the designers in getting an idea of the current available practices as well as recording the data regarding efficient practices for future references as well.

12. Please discuss some best principles and guidelines associated with value engineering and management for housing projects.

There are a few principles of VE and VM which are followed by the experts to get the maximum outputs. One of the respondents said that, 'Implementation of the VE and VM during the planning phases proves to be most effective' while other commented, 'The project value must be kept in the top, even above the cost'. The use of VE during the initial or planning phases was recommended by majority of interviewees. One of the most important responses included, 'value engineering must be applied in planning phase and must be used to identify all the potential risks associated with the project in the beginning'. One of the interviewees suggested that, 'a subcontractor must be hired in the beginning of the project to identify the risks associated with the project and manage the project in an effective manner'. Some others highlighted that as per the guidelines, the projects must be completed before the actual time of project completion. All the responses given by the experts had an aim of reducing the time and cost deadlines and completing the project with the highest quality.

13. Please recommend some strategies that can help in improving the implementation of value management in UAE housing projects.

There were a large number of recommendations provided by the interviewees with respect to implementation of value engineering. One of the interviewees said, 'The Construction Company

and designers must obtain all the required construction permits before the commencement of the project so that they do not face problems while project execution'. Another manager said, 'The units at the worksite must be already prepared before the project starts so that it saves the initial time'. Another respondent said, 'The project production or drawing and the repair method for the repair and reconstruction must already be determined within the guarantee period and the tolerance values must be predetermined'. A few others also suggested the adoption of effective methods to determine the risks in the initial phases and gathering all the procurement details in the planning phase. All these methods may prove to be helpful in implementing effective value engineering practices.

14. Do you wish to comment freely on the use of VE in housing construction in the UAE ?

'In my opinion, Value engineering is one of the latest technologies introduced in the housing construction sector in UAE. The technique should be well learnt and must be taught to the designers properly', these words or related words were said by a number of respondents. Another topic which received a heavy support from the experts was related to the training of the designers and developing the required VE skill set in them. Another manager said that, 'I support value engineering and management as it has proven to be effective enough to reduce time and cost frames of many projects worldwide and has ensured customer satisfaction, UAE also needs such revolutionary technique as it is going through the phase of maximum infrastructure development'.

APPENDIX V: QUESTIONNAIRE FOR VALIDATION

Planning stage

There is need for the utilisation of the effective tools for determining the factors which can influence the variables associated with value engineering

The VE should be implemented in each and every stage of the project

The workshops related to VE should be organised in planning stage.

The clients and contractors should be involved in VE implementation

It is important to plan and develop the VE culture and environment in the organisation

Implementation Stage

The workshops related to VE should be organised in implementation stage

The practical steps should be taken towards implementation of the VE culture and environment within the organisation

The sustainable measures need to be taken for complying with the sustainable practices and the contractors should be responsible for it

The monitoring and evaluation process need to be done at regular intervals

APPENDIX VI: COVER LETTER FOR SURVEY AND INTERVIEW

Survey cover letter

Date

Dear ……,

Invitation: Request to participate in an online survey

I am conducting an online survey to collect some relevant information related to value engineering in UAE (housing) construction. You are being approached for this purpose because of your knowledge and experience related to this area.
This survey is a part of my PhD study with the University of Wolverhampton – UK, under the supervision of Dr Ezekiel Chinyio.

You will require approximately 25-30 minutes to complete the survey and most questions provide multiple-choice answers for you to tick the most appropriate answer/s. Please note that there are no right or wrong answers. It is your opinion about value engineering that counts. If you choose to participate in this survey then please click on the online survey link provided in the email. All information provided will be treated in very strict confidence. Your identity and the name of your organisation will not be revealed in any report.

Please note that participation in the survey is completely voluntary i.e. you may choose not to participate in the survey at any point of time.

I would be truly thankful to you if you could take some time from your busy schedule to complete the survey. The data collected in this survey will help me accomplish my study related to this area. If you require some additional information then please feel free to contact me on [email address redacted] .

Sincerely,

(Student's Name)

Interview cover letter

Date

Dear ……,

Invitation: Request to participate in a research interview

I wish to request for an interview with you to obtain some relevant information related to value engineering in UAE (housing) construction. You are being approached because of your knowledge and experience related to this area. This interview is a part of my PhD study with the University of Wolverhampton – UK, under the supervision of Dr Ezekiel Chinyio.

The interview will involve 12 questions and last about 30 minutes only. I am available to do the interview at your preferred venue and time of day. I am following ethical procedures during the interviews and in this regard will need to ask you to sign a consent form before the interview. In order to make the interview last a very short time, I will like to request your permission to audio-record the discussion instead of taking notes. I will later transcribe and analyse the information. All information provided will be treated in very strict confidence. Your identity and the name of your organisation will not be revealed in any report.

I would be truly thankful to you if you could give me some of your valuable time to discuss with me on value engineering in UAE (housing) construction as this will help me to accomplish my study related to this area.

I hope to get a positive response from you and look forward to your reply.

Yours sincerely

(.....)

APPENDIX VII: CONSENT FORM

Consent to take part in research

- I..... voluntarily agree to participate in this research study.

- I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

- I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.

- I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.

- I understand that participation involves answering of survey/interview questions.

- I understand that I will not benefit directly from participating in this research.

- I agree to my interview being audio-recorded.

- I understand that all information I provide for this study will be treated confidentially.

- I understand that in any report on the results of this research my identity will remain anonymous. This will be done by changing my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

- I understand that disguised extracts from my interview may be quoted in dissertation, conference presentation and published papers.

- I understand that if I inform the researcher that myself or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.

- I understand that signed consent forms and original audio recordings will be retained in the password protected laptop which can be accessed by researcher only. Also, data will be retained until the exam board confirms the results of dissertation.

- I understand that a transcript of my interview in which all identifying information has been removed will be retained for two years from the date of the exam board.

- I understand that under freedom of information legalisation I am entitled to access the information I have provided at any time while it is in storage as specified above.

- I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

Signature of research participant

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Signature of participant Date

Signature of researcher

I believe the participant is giving informed consent to participate in this study

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Signature of researcher Date